Check List the journal of biodiversity data

ANNOTATED LIST OF SPECIES

Check List 17 (3): 931–974
https://doi.org/10.15560/17.3.931

PENSOFT

Checklist of aroids (Alismatales, Araceae) from Sabah (Malaysian Borneo)

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Abstract

One hundred and fourteen species belonging to 29 genera of Araceae are recorded from Sabah: *Aglaonema* Schott, *Alocasia* (Schott) G.Don, *Amorphophallus* Blume ex Decne., *Amydrium* Schott, *Anadendrum* Schott, *Arisaema* Mart., *Bucephalandra* Schott, *Colobogynium* Schott, *Colocasia* Schott, *Cryptocoryne* Fisch. ex Wydler, *Cyrtosperma* Griff., *Epipremnum* Schott, *Gamogyne* N.E.Br., *Homalomena* Schott, *Lasia* Lour., *Lemna* L., *Nabalu* S.Y.Wong & P.C.Boyce, *Ooia* S.Y.Wong & P.C.Boyce, *Phymatarum* M.Hotta, *Pistia* L., *Pothos* L., *Rhaphidophora* Hassk., *Pursegloveia* S.Y.Wong, S.L.Low & P.C.Boyce, *Rhynchopyle* Engl., *Schismatoglottis* Zoll. & Moritzi, *Scindapsus* Schott, *Spirodela* Schleid., *Tawaia* S.Y.Wong, S.L.Low & P.C.Boyce, *Typhonium* Schott, and *Wolffia* Horkel ex Schleid. Two genera, *Cryptocoryne* and *Phymatarum*, are newly recorded from Sabah. One species, *Pothos leptostachyus* Schott, is newly recorded from Sabah. One genus, *Tawaia*, and 50 species are endemic to Sabah. Taxonomic notes, an identification key to genera, and comments on habitat and ecology of the species are presented.

Keywords

Biodiversity, endemic species, Malesia, taxonomy

Academic editor: M. Nazre | Received 25 January 2021 | Accepted 20 April 2021 | Published 17 June 2021

Citation: Wong SY, Joling J (2021) Checklist of aroids (Alismatales, Araceae) from Sabah (Malaysian Borneo). Check List 17 (3): 931–974. https://doi.org/10.15660/17.3.931

Introduction

Scientific study of the flora of Sabah began with the earliest ascents of Mount Kinabalu by foreigners, beginning with Hugh Low in 1851 (Low 1852), the expedition of Low and Spenser St. John in 1858 (St John 1862, 1863), and the commercial collecting trips by Frederick Burbidge in 1877 and 1878 when Burbidge was joined by Peter Veitch for the first and for the second by a Mr Smith seconded to him by Andrew Boosie, the general manager of the Labuan coal mines (Burbidge 1880; Moulton 1915). The botanical discoveries of these early explorations, mainly *Rhododendron* L. and *Nepenthes* L., were written up by Joseph Hooker (1852, 1860). However, curiously except for Burbidge, none these ascents produced any aroid discoveries despite the abundance of family on the lower altitudes of the mountain range. Indeed, only three aroids, *Gamogyne burbidgei* N.E.Br., *Piptospatha insignis* N.E.Br., and what Burbidge assumed to be a second *Piptospatha* N.E.Br., are enumerated, with

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none described from Sabah; *Gamogyne* N.E.Br. was described from Bukit Sagan in Sarawak (Brown 1882), while *Piptospatha insignis* (Brown 1879; Hooker 1881) was for 135 years from an unknown location until its rediscovery in Sarawak (Boyce and Wong 2013a). However, there exists in the Kew herbarium a sheet of notes in Burbidge's hand, also cited by Brown (1882: 196), in which Burbidge explained that he discovered a second species (of *Piptospatha*) about 100 miles farther north than the *Gamogyne*, fringing the Dahombang and Kina Taki streams, near "Kina Balu", but he lost both the living plants and herbarium specimens. This species was almost certainly *Ooia kinabaluensis* (Bogner) S.Y.Wong & P.C.Boyce, which was eventually described in 1984, initially as a species of *Hottarum* Bogner & Nicolson, by Josef Bogner (1984).

The next botanical-focussed ascent of the mountain was in 1892 when George Haviland, at the time Curator of the Sarawak Museum in Kuching, accompanied by his cousin, spent two months on the mountain. Their collections formed the basis for Otto Stapf's *On the Flora of Mount Kinabalu, in North Borneo* (Stapf 1894). Stapf's paper lists only one aroid, *Gamogyne burbidgei*, based on a Burbidge collection from Paka Paka, a village on the road between Tuaran and Kota Belud. It seems extraordinary that Haviland, an acute field-observer, failed to collect any aroids during the two months he spent on the mountain, as his Sarawak collections contain numerous excellent specimens of Araceae.

From February 1910 Lilian Gibbs, accompanied by D.R. Maxwell, Assistant District Officer, of Keppel Province, spent three months botanizing Kinabalu from which Gibb's remarkable 1914 publication, *A Contribution to the Flora and Plant Formations of Mount Kinabalu and the Highlands of British North Borneo* (Gibbs 1914) was the output. Just four species of Araceae were written up for Gibbs by Henry Ridley. One of these (*Arisaema simplicifolium* Ridl.) was described as a new species and of the other three *Rhaphidophora peepla* (Roxb.) Schott was misidentified and later described by Furtado (1935) as *Rhaphidophora kinabaluensis* Furtado [now *Scindapsus kinabaluensis* (Furtado) Kartini & P.C.Boyce (Kartini et al. 2015b)], while *Schismatoglottis caulescens* Ridl., also misidentified, remains a mystery, as the material is inadequate to identify. The fourth, *Epipremnopsis huegelii* Engl. ('*huegeliana*' in Gibbs 1914), is a synonym of *Amydrium medium* (Zoll. & Moritzi) Nicolson. Thus, 63 years of botanical exploration in Sabah had logged only six aroid species in as many genera.

While exploration and collecting activity on the west coast made gradual progress, an agreement between the Philippine Bureau of Science and the Forestry Service of British North Borneo enabled the Bureau of Science collector Maximo Ramos to undertake 3½ months' work in the lowlands in the vicinity of Sandakan in 1920 (Merrill 1922). A similar agreement already in existence with Sarawak (Merrill 1915) had greatly enabled the compilation of Elmer Merrill's *A bibliographic enumeration of Bornean Plants* (Merrill 1921; upon which Masamune (1942) drew heavily), and, predictably, Merrill (1922a, 1922b) was soon active on the material Ramos collected, describing from among them two new aroids: *Pothos mirabilis* Merr. and *Schismatoglottis ferruginea* Merr.

Botanical exploration in Kinabalu continued in 1915 with the first visit to Kinabalu by the indomitable wife and husband team of Joseph and Mary Clemens. Although the Clemenses did collect some aroids, nothing was published until Furtado, based at Singapore, accompanied them to Kinabalu in 1932, and from which Furtado's 1935 and 1939 *Araceae Malesicae I* and *II* were produced. Together these papers including the description of five new species for Sabah: *Homalomena gillii* Furtado, *H. kinabaluensis* Furtado, *Pothos kinabaluensis* Furtado, *Rhaphidophora kinabaluensis* (now transferred to *Scindapsus* Schott; Kartini et al. 2015b), and *Schismatoglottis retinervia* Furtado. A sixth species, *Pothos borneensis* Furtado, was based on a Sarawak type and listed a Kinabalu collection as a paratype, but there remains doubt as to the identity of this rather poor specimen, although its placement in *Pothos* L. seems correct. By the onset of the Second World War the recorded Araceae flora of Sabah stood at 12 species in seven genera: *Amydrium medium*, *Arisaema simplicifolium, Gamogyne burbidgei*, *Homalomena gillii*, *Homalomena kinabaluensis*, *Pothos kinabaluensis*, *Pothos mirabilis*, *Pothos* '*borneensis*' [identity remains unknown], *Rhaphidophora peepla [now identified Scindapsus kinabaluensis*], *Schismatoglottis* '*caulescens*' [identity remains unknown], *Schismatoglottis ferruginea*, and *Schismatoglottis retinervia*. In addition, collections made by the Clemenses and by Furtado during his time with the Clemenses include specimens of what are now described species: *Nabalu corneri* (A.Hay) S.Y.Wong & P.C.Boyce, *Ooia kinabaluensis*, and *Schismatoglottis ahmadii* A.Hay.

The war and the following upheavals led to a decline in botanical exploration until the 1960s when the Royal Geographical Society mounted their North Borneo Expedition in 1961 (Corner 1962). One result was good collections of the gargantuan *Schismatoglottis corneri* A.Hay (now *Nabalu corneri*; Hay and Yuzammi 2000; Low et al. 2018). Also, in the 1960s Kyoto University mounted a Borneo expedition that while mainly focusing on Sarawak (notably the Ulu Kakus and Mulu areas) and Brunei, also spent a few days in the Sandakan area (Hotta 1965). Of particular note for Araceae is that the Kyoto group included Mitsuru Hotta, who would be catalytic in revitalizing Araceae work in tropical Asia and would return to Kinabalu in 1968 and 1969 (Boyce 2015).

The start of current research activities in Sabah can be traced back to the late 1980s beginning with the description the spectacular *Amorphophallus lambii* Mayo & Widjaja (Mayo et al. 1982). A few years later, Alistair Hay began a remarkable and continuing

series of contributions, initially resulting from his doctorate (Hay 1988), and continuing to a comprehensive bibliography and checklist (Hay et al. 1995). A regional account for *Colocasia* was published including description of the remarkable indigenous mountain taro *Colocasia oresbia* A.Hay (Hay 1996). The description of the striking ultramafic-restricted *Alocasia melo* A.Hay, P.C.Boyce & K.M.Wong (Hay et al. 1997) was followed by a regional account for *Alocasia* (Schott) G.Don (Hay 1998), which included description of four new species for Sabah—*A. pangeran* A.Hay, *A. principiculus* A.Hay, *A. puteri* A.Hay, and *A. wongii* A.Hay—and Sabah was confirmed as the origin of the long-cultivated extraordinary *Alocasia cuprea* (C.Koch & Bouché) C.Koch. In 2000 Hay published a revision of *Schismatoglottis*, including 12 new Sabahan species: *Schismatoglottis ahmadii* A.Hay, *S. clemensiorum* A.Hay, the garguantuan *S. corneri* A.Hay (originally collected by Furtado but never described), *S. crinitissima* A.Hay, *S. decipiens* A.Hay, *S. lingua* A.Hay, *S. moodii* A.Hay, *S. silamensis* A.Hay, *S. trusmadiensis* A.Hay & J.Mood, *S. unifolia* A.Hay & P.C.Boyce, *S. venusta* A.Hay, and *S. wongii* A.Hay. A thirteenth novelty, *S. tahubangensis* A.Hay & Herscovitch, was added in 2003 (Hay and Herscovitch 2003).

In the 1990s, Peter Boyce turned attention to various Bornean aroid genera including *Epipremnum* Schott (Boyce 1998), *Rhaphidophora* Hassk. (Boyce 2001), and *Pothos* (Boyce and Hay 2001), and participated together with Baharuddin Suleiman and Jain Linton in an expedition to the Crocker Range where at its northern extremity stands Mount Kinabalu (Boyce et al. 2002); their expedition resulted in a checklist expanding on that in Beaman and Beaman (1998). Also in the 1990s, Wilbert Hetterscheid began to publish on *Amorphophallus* Blume ex Decne., adding four species: *Amorphophallus hottae* Bogner & Hett., *A. rugosus* Hett. & A.L.Lamb, *A. tinekeae* Hett. & A.Vogel, and *A. venustus* Hett., A. Hay & J.Mood (Bogner and Hetterschied 1992; Hetterschied 1994; Hetterscheid and van der Ham 2001).

In the 2000s, Boyce was again joined by Baharuddin Suleiman in describing *Homalomena galbana* Baharuddin & P.C. Boyce from the remarkable Maliau Gorge (Baharuddin and Boyce 2010). A series of papers followed with Wong Sin Yeng and Kartini Saibeh describing new species of *Homalomena* Schott, *Schismatoglottis* Zoll. & Moritzi, and *Piptospatha* primarily from central and east Sabah (Boyce and Wong 2013; Boyce et al. 2019; Kartini et al. 2015a, 2017, 2019, 2020; Wong et al. 2018, 2019), and Boyce with David Scherberich described an astonishing new ornamental *Schismatoglottis* (*S. scintillans* Scherberich & P.C. Boyce (Scherberich and Boyce 2013). Most recently a Sabahan, Jyloerica Joling has begun work on the aroids of Sabah for her M.Sc. research (Wong et al 2020a, 2020b), which includes the critical checklist presented here.

As molecular work clarifies relationships among aroid species and enables more critical analyses of generic boundaries, it becomes clear that some significant alterations are required to the taxonomy of aroids, notably in the Schismatoglottideae, a tribe that is particularly diverse and speciose on Borneo. One outcome pertinent to Sabah has been the recognition that *Piptospatha* (sensu Bogner and Hay 2000) is monotypic, and thus not recorded from Sabah, with the species previously assigned to *Piptospatha* actually belonging to *Rhynchopyle* Engl. (Low et al. 2018) and *Ooia* S.Y. Wong & P.C.Boyce (Wong and Boyce 2016), and that one species previously assigned to *Aridarum* as *A. sabahense* S.Y.Wong, S.L.Low & P.C.Boyce (Wong et al. 2014) in fact is a monotypic genus, now described as *Tawaia* S.Y.Wong, S.L.Low & P.C.Boyce (Low et al. 2018); additionally, the gigantic *Schismatoglottis corneri*, which is such a prominent feature of the west coast flora, is itself best accommodated in its own genus, *Nabalu* S.Y.Wong & P.C.Boyce. Thus, this paper provides an up-to-date checklist of Araceae in Sabah.

Study Area

The study was carried out in Sabah, which has an area of 73,371 km^2, in the northern part of Borneo. Sabah accounts for approximately 10% of Borneo's total land area (Marsh and Greer 1992; Fig. 1). The altitude ranges from sea level up to 4095 m at the highest point on Mount Kinabalu. The average annual temperature ranges between 32 °C in the lowlands and 21 °C in the highlands. The mean annual rainfall is between 2500 mm and 3500 mm, with the highest rainfall occurring on Mount Kinabalu and in the Crocker Range (Juiling et al. 2020). Fifty-one distinct soil associations have been described based on differences in soil texture, nutrient availability, and drainage, and 19 distinct floristics associations are recognised within the State of Sabah (Sabah Forestry Department 2004). The lowland and upland areas with well-drained and moderately fertile to fertile soils are dominated by mixed dipterocarp forests. Kerangas (heath) forests are found on areas with podzolic soils in the lowland, upland, and montane regions. Freshwater swamp and peat swamp forests occur in the lowland on soils with an impeded drainage. Ultramafic forests are found on serpentine soils (Juiling et al. 2020). Lower montane forests occur on the moderate fertile soils at altitudes above 1000 m. This transition to upper montane forest occurs at an elevation of approximately 2500 m. It is replaced by subalpine vegetation at altitudes above 3500 m on the upper reaches of Mount Kinabalu (Sabah Forestry Department 2004). However, aroids are only found at below 1900 m elevation on Borneo (Boyce et al. 2010).

Methods

The checklist is based on observations of specimens from BORH, SAN, SAR, and SNP. Online herbarium

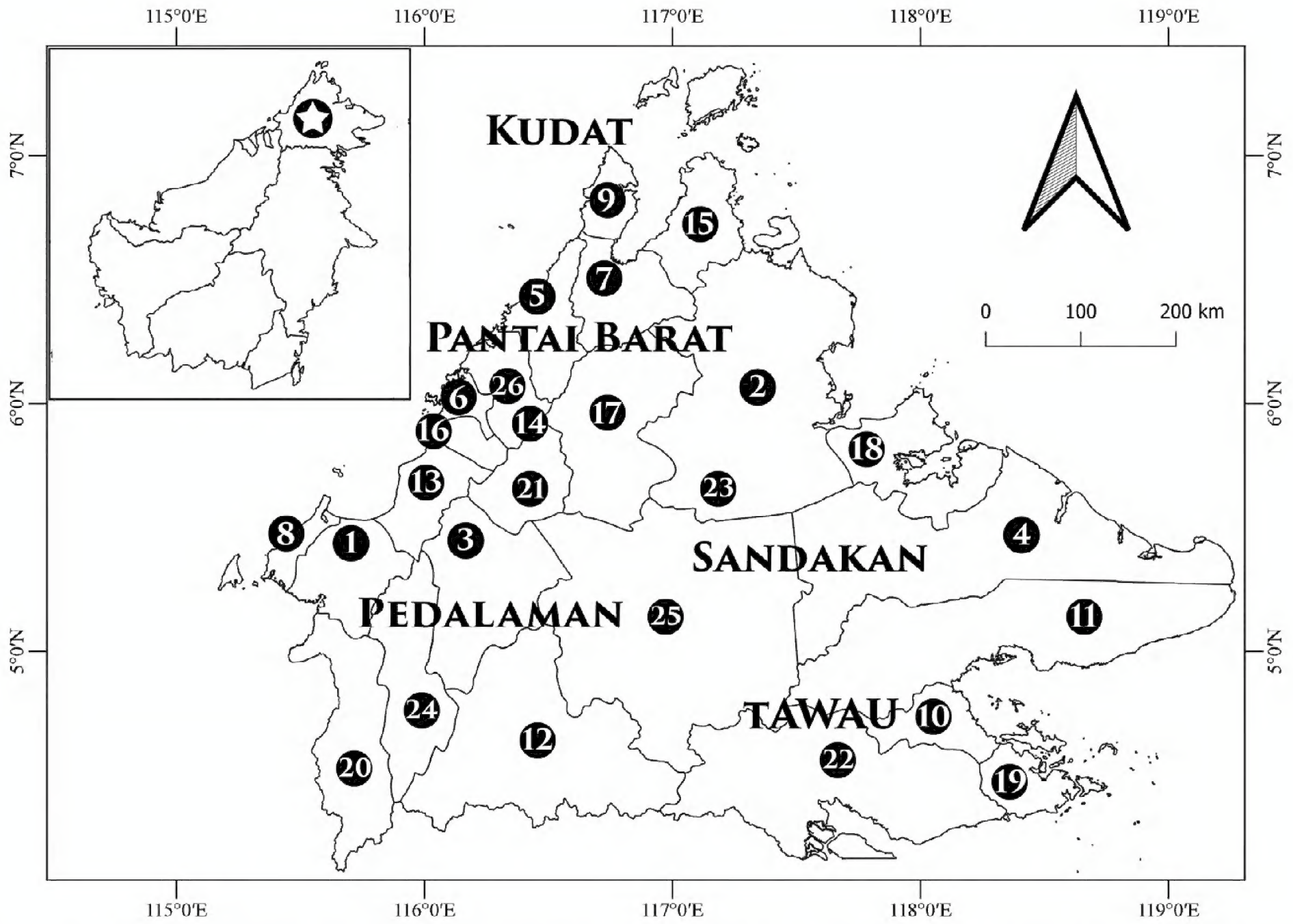

Figure 1. Map of divisions and districts of Sabah. = Sabah; 1 = Beaufort; 2 = Beluran; 3 = Keningau; 4 = Kinabatangan; 5 = Kota Belud; 6 = Kota Kinabalu 7 = Kota Marudu; 8 = Kuala Penyu; 9 = Kudat; 10 = Kunak; 11 = Lahad Datu; 12 = Nabawan; 13 = Papar; 14 = Penampang; 15 = Pitas; 16 = Putatan; 17 = Ranau; 18 = Sandakan; 19 = Semporna; 20 = Sipitang; 21 = Tambunan; 22 = Tawau; 23 = Telupid; 24 = Tenom; 25 = Tongod; 26 = Tuaran.

images from A, E, K, L, and P were also accessed. All specimens have been seen apart from duplicates deposited at AA, AAU, AAH, BO, BRUN, C, KEP, KRB, KYO, M, MO, NSW, PNH, SING, US, and UPM (Index Herbariorum 2020). Specimens without geographic coordinates were georeferenced using Google Earth and the Sabah Gazetter (Tangah and Wong 1995). An extensive literature search was carried out for species without specimens seen (indicated in species list below). For identifications, the following taxonomic treatments were consulted: Gibbs (1914), Furtado (1935, 1939), Nicolson (1969), Jacobsen (1985), Hay (1992, 1996, 1998), Bogner and Hetterscheid (1992), Boyce and Poulsen (1993), Boyce (1994, 1998, 1999, 2000, 2001, 2009), Hetterscheid (1994), Hetterscheid and Ittenbach (1996), Nguyen and Boyce (1999), Bogner and Hay (2000), Hay and Yuzammi (2000), Boyce and Hay (2001), Hetterscheid and van der Ham (2001), Gusman and Gusman (2006), Ahmad Sofiman and Boyce (2010), Baharuddin and Boyce (2010), Boyce et al. (2010), Li and Landolt (2010), Boyce and Wong (2013), Wong et al. (2013, 2014, 2018, 2020a, 2020b), Kartini et al. (2015a, 2015b), Low et al. (2018), and Okada et al. (2020). All identified taxa were compared with the types. In the case that type material was absent, the database of digitized plants (JSTOR Global Plants) was consulted (Gallagher 2010). The descriptive terminology follows Mayo et al. (1997). The determination of terrestrial, epiphytic, and nomadic vine life forms was made using the classifications proposed by Croat (1988) and Zotz (2013). The distribution and ecological sections follow literature cited and notes on the specimens.

Results

Twenty-nine aroid genera are recorded for Sabah: *Aglaonema* Schott, *Alocasia*, *Amorphophallus*, *Amydrium* Schott, *Anadendrum* Schott, *Arisaema* Mart., *Bucephalandra* Schott, *Colobogynium* Schott, *Colocasia* Schott, *Cryptocoryne* Fisch. ex Wydler, *Cyrtosperma* Griff., *Epipremnum*, *Gamogyne*, *Homalomena*, *Lasia* Lour., *Lemna* L., *Nabalu*, *Ooia*, *Phymatarum* M.Hotta, *Pistia* L., *Pothos*, *Rhaphidophora*, *Pursegloveia* S.Y.Wong, S.L.Low & P.C.Boyce, *Rhynchopyle*, *Schismatoglottis*, *Scindapsus*, *Spirodela* Schleid., *Tawaia*, *Typhonium* Schott, and *Wolffia* Horkel ex Schleid. The total number of described species and number of species yet to be described are 114 and 125, respectively (Table 1). Appendix Table A1 provides the list of aroid species in Sabah including the non-examined species in this study.

Table 1. List of genera, number of species described/endemic species, and novel species yet to be described per genus.

Genus	No. of species described / no. of endemic species	No. of estimated new species
Aglaonema Schott	2/0	
Alocasia (Schott) G.Don	13/5	
Amorphophallus Blume ex Decne.	5/4	
Amydrium Schott	1/0	
Anadendrum Schott	0/--	10
Arisaema Mart.	3/1	
Bucephalandra Schott	2/2	2
Colobogynium Schott	1/0	
Colocasia Schott	2/1	
Cryptocoryne Fisch. ex Wydler	1/0	
Cyrtosperma Griff.	2/0	
Epipremnum Schott	2/0	
Gamogyne N.E.Br.	1/0	
Homalomena Schott	11/8	50
Lasia Lour.	1/0	
Lemna L.	3/0	
Nabalu S.Y.Wong & P.C.Boyce	1/0	
Ooia S.Y.Wong & P.C.Boyce	1/0	3
Phymatarum M.Hotta	1/0	
Pistia L.	1/0	
Pothos L.	14/4	3
Rhaphidophora Hassk.	7/1	2
Pursegloveia S.Y.Wong, S.L.Low & P.C.Boyce	1/1	
Rhynchopyle Engl.	1/1	2
Schismatoglottis Zoll. & Moritzi	24/20	50
Scindapsus Schott	8/1	3
Spirodela Schleid.	2/0	
Tawaia S.Y.Wong, S.L.Low & P.C.Boyce	1/1	
Typhonium Schott	1/0	
Wolffia Horkel ex Schleid.	1/0	
Total	114/50	125

Generic key to the Araceae of Sabah

(modified from Boyce et al. 2010; Low et al. 2018)

1a. Plants comprising small to minute, few-rooted or rootless, free-floating, thallus-like, leafless bodies 2

1b. Plants not as above. If free-floating, then leaves forming a conspicuous rosette with copious roots hanging beneath 4

2a. Roots 1–21 per plant body; plant body with 1–21 veins; the daughter plant bodies and inflorescences originating from 2 lateral pouches at the base of the plant body 3

2b. Roots absent; plant body without veins; the daughter plant bodies originating from a single terminal pouch or cavity at the base of the plant body; inflorescence originating in a cavity on the plant body upper surface ..... *Wolffia*

3a. Roots (0–) 2–21 per plant body; plant bodies with (3–) 5–21 veins, surrounded at its base by a small scale (prophyll) covering the point of attachment of the roots ..... *Spirodela*

3b. Roots 1 per plant body; plant bodies with 1–3 veins, without a scale at the base ..... *Lemna*

4a. Flowers bisexual each with a perigone of conspicuous tepals 5

4b. Flowers bisexual without a perigone of conspicuous tepals, or unisexual 7

5a. Armoured helophytes 6

5b. Climbing hemiepiphytes ..... *Pothos*

6a. Stems suffruticose, erect to decumbent, usually with prickly conspicuous internodes; leaves hastate to pinnatifid; spathe caducous, rarely marcescent; placentation apical; fruit spinulous ... *Lasia*

6b. Stem a condensed rhizome, rarely with distinct internodes, and these then unarmed; leaves entire, sagittate to hastate; spathe persistent to marcescent; placentation not apical; fruit smooth ..... *Cyrtosperma*

7a. Flowers bisexual, perigone if present membranous and inconspicuous; mainly climbing hemiepiphytes, rarely rheophytic 8

7b. Flowers unisexual 12

8a. Spathe in bud stout, short- to long-slout-pedunculate, not conspicuously long-beaked, if beak present then less than ⅙ length of entire spathe, opening with inside yellow, orange, greenish or white, only moderately waxy. Flowers naked. Infructescence a monsterocarp or, if with discrete berries, then these not truncate, and ripening white. Trichosclereids present (but sparse in *Amydrium*)..... 9

8b. Spathe in bud slender, long-slender-pedunculate, conspicuously long-beaked (beak to ⅓ length of entire spathe), opening with inside greenish white or white and conspicuously glossy-waxy. Flowers with a membranous perigon of fused tepals. Infructescence with discrete, truncate berries ripening red or orange. Trichosclereids absent ..... *Anadendrum*

9a. Adult leaf leaf blade pinnate *and* conspicuously perforated. Higher order venation completely reticulate. Infructescence with discrete berries ripening white. Trichosclereids sparse ... *Amydrium*

9b. Trichosclereids abundant (with many hair-like structures when leaf blade is broken). Higher order venation striate or reticulate 10

10a. Ovules 2–6 or more, placentation parietal. Fruits with more than 1 seed 11

10b. Ovules solitary, placentation basal. Fruits with a solitary seed ..... *Scindapsus*

11a. Ovules 8 or more, superposed on 2 (rarely 3) parietal placentas. Seeds many, ellipsoid, straight, 1.3–3.2 mm long, 0.6–1 mm wide; testa brittle, smooth .....*Rhaphidophora*

11b. Ovules 2–4 (–6) at base of a single intrusive placenta. Seeds few, curved, 3–7 mm long, 1.5–4 mm wide; testa bony and ornamented ..... *Epipremnum*

12a. Free-floating plants with leaves forming a conspicuous rosette, with copious roots hanging beneath ..... *Pistia*
12b. Not so 13
13a. Leaf blades 14
13b. Leaf blades simple, ranging from linear-lanceolate to hastate 15
14a. Leaf blades decompound. Inflorescences appearing before leaf emergence, with flowers of both sexes ..... *Amorphophallus*
14b. Leaf blades trifoliolate to pentafoliolate. Inflorescences produced with leaves, single-sexed .... *Arisaema*
15a. Aquatic plants. Infructescences composed of dehiscent carpels ..... *Cryptocoryne*
15b. Plants not aquatic. Infructescences comprised of berries 16
16a. Plants suffruticose. Fruits conspicuous red or pink berries not surrounded by a persistent spathe ..... *Aglaonema*
16b. Plants not suffruticose. Fruits various, if red or orange red berries then surrounded by a persistent spathe 17
17a. Entire spathe closing after anthesis and then persisting until fruit maturity, basally circumcissile to release fruits ..... *Homalomena*
17b. Upper spathe mostly shedding during or soon after anthesis, and lower spathe persisting until fruit maturity and then splitting basicopically to release fruits; if upper spathe persisting then attached portion of petiolar sheath very short and the remainder free-ligular *or* absent and the protective role taken on by prophy/cataphyll 18
18a. Staminate flowers forming synandria 19
18b. Staminate flowers not forming synandria 20
19a. Infructescences erect, fruits medium-sized, ripening orange-red, odourless ..... *Alocasia*
19b. Infructescences pendent, fruits small, ripening yellowish brown, smelling variously of overripe fruit or vomit ..... *Colocasia*
20a. Tuberous-stemmed geophytes. Sterile flowers between the staminate and pistillate flower zones filamentous and tangled. Spadix with a long, naked appendix ..... *Typhonium*
20b. Mesophytes, rheophytes, lithophytes and chasmophytes with stems never tuberous. Sterile flowers between the staminate and pistillate flower zones if present never filamentous and tangled. Spadix appendix, if present, never naked 21
21a. Wings of petiolar sheath fully or almost fully attached to the petiole; seeds never with a micropylar appendage ..... *Schismatoglottis*
21b. Wings of petiolar sheath always extended into a free ligular portion; seeds sometimes with micropylar appendage..... 22
22a. Thecae with needle- or horn-like extensions from tips of which pollen is extruded as a droplet 23
22b. Thecae without needle- or horn-like extensions; thecae surface flat or with a deep pit; pollen extruded in powdery masses or as strings 26
23a. Spathe limb separated from lower spathe by an abrupt constriction; staminate flowers and staminodes conspicuously tuberculate; interstice staminodes static, closely resembling staminate flowers; fruiting spathe urceolate, actively splitting to reveal fruits ..... *Phymatarum*
23b. Spathe not or only very faintly constricted; staminate flowers and staminodes smooth or only weakly tuberculate; interstice staminodes motile, flattened, dissimilar to staminate flowers; fruiting spathe a tubular, salverform or funnelform splash-cup 24
24a. Inflorescence nodding; infructescence erect by post-anthesis flexing of peduncle, or pendulous ..... *Tawaia*
24b. Inflorescence and infructescence erect 25
25a. Interstice staminodes (if present) static, deciduous post-anthesis; stamen connective expanded on the distal side into a conspicuous rim .... *Pursegloveia*
25b. Interstice staminodes shield-like, erect during pistillate anthesis, reflexing during staminate anthesis, persisting post-anthesis, becoming photosynthetic, and functioning to seal orifice of splash-cup and protect developing fruits; stamen connective not expanded into a conspicuous rim ..... *Bucephalandra*
26a. Massive arborescent pachycaul to ca. 4 m tall; peduncle very stout, to ca. 45 cm long, 3 cm thick, apically down-turned so inflorescences abruptly pendulous; spathe to 36 cm long; spadix ca. 29 cm long; staminate and pistillate flower zones contiguous ..... *Nabalu*
26b. Not this combination 27
27a. Shoot modules monophyllous; petiolar sheath reduced to a very short collar; persistent lower spathe splitting at peduncle/spathe insertion, spathe walls curling acroscopically to release fruits ..... *Colobogynium*
27b. Shoot modules polyphyllous; petiolar sheath extensive; persistent lower spathe splitting at the top or middle, spathe walls curling basiscopically or medi- oscopically to release fruits, or forming a splash-cup or a non-splitting tubular structure with a restricted orifice 28
28a. Pistillate flowers connate, berries forming a syncarpium ..... *Gamogyne*
28b. Pistillate flowers free, berries free 29

29a. Entire spadix axis persistent until after fruit dispersal; spent flowers individually shedding to leave conspicuous scars ..... *Ooia*

29b. Pistillate portion of spadix persistent after anthesis, rest of axis shed ..... *Rhynchopyle*

Aglaonema nitidum (Jack) Kunth

Material examined. MALAYSIA – **Pedalaman** • Beaufort, Kuala Penyu, Kepayan, Kampung Memalad; 05°27′40″N, 115°28′33″E; 50 m elev.; 1 December 1999; Diwol S. SAN 89424 (SAN) • Keningau, Kitau, Sungai Tumpason; 05°29′33″N, 116°16′25″E; 7 September 1982; Amin SAN 95339 (SAN) • Keningau, Sungai Apin-apin; 05°29′28″N, 116°15′46″E; 19 February 1998; Diwol S. SAN 135342 (SAN) • Keningau, Ulu Senagang; 05°21′05″N, 116°01′26″E; 558 m elev.; 19 May 2010; Markus SAN 151903 (SAN) • Pensiangan, Pensiangan Utara, Kampung Batu, Bukit Pun Batu; 04°47′30″N, 116°11′33″E; 609.6 m (2000 ft.) elev.; 25 October 1996; S. P. Lim 1537 (SAN) • Pensiangan, Sapulut, Batu Punggul; 05°08′26″N, 118°08′03″E; 28 January 1993; Fidilis Krispinus SAN 135784 (SAN) • Sipitang, Ganui Forest Reserve; 04°59′43″N, 115°41′04″E; 229 m elev.; 17 March 2011; J. T. Pereira SAN 153510 (SAN) • Tenom, Bukit Tenom; 05°07′20″N, 115°56′39″E; 23 January 1964; W. Meijer SAN 41164 (SAN) • Tenom, Ulu Kalang Forest Reserve; 5°9′43″N, 115°55′42″E; 683 m elev.; 6 March 2018; Alviana D. SAN 158869 (SAN) • Tenom, Ulu Tomani, Kampung Kaang, 3 Miles from Kampung Kaang; 05°09′14″N, 115°56′39″E; 14 June 1979; Leopold M. SAN 90849 (SAN) – **Pantai Barat** • Penampang, Moyog along the road between Kota Kinabalu and Tambunan, 21 miles SE of Kota Kinabalu; 05°50′N, 116°14′E; 460 m elev.; 26 September 1981; T. B. Croat 53113 (SAR, MO) • Ranau, Sungai Nabutan; 05°52′21″N, 116°49′13″E; 23 March 1982; Aban G. SAN 94574 (SAN) – **Kudat** • Pitas, Hutan Simpan Paitan; 06°23′35″N, 117°25′11″E; 15 May 1987; George & Amin SAN 121275 (SAN) – **Sandakan** • Beluran, Sungai Sugut, 06°14′01″N, 117°18′54″E; 2 October 1961; W. Meijer SAN 27611 (SAN) • Kinabatangan, Sukau, Pangi Forest Reserve, Temanggong Besar Hill; 05°31′38″N, 118°18′54″E; 18 September 1996; S. P. Lim 1242 (SAN).

Identification. This species is characterized by the leaf blade without conspicuous venation and not variegated; petiolar sheaths are long with scarious sheath margins. The spathe of the inflorescence is persistent until late fruiting (Nicolson 1969).

Distribution and ecology. Widespread in Sabah. Lowland to upper hill evergreen gallery forest, peat-swamp forest.

Aglaonema simplex Blume

Material examined. MALAYSIA – **Pendalaman** • Beaufort, mile 62¾ rail-line; [05°19′07″N, 115°47′50″E]; 22 March 1962; George Mikil, SAN 34539 (SAN) • Pensiangan, Batu Urud, on shaded limestone rocks; 04°46′04″N, 116°38′05″E; 9.144 m (30 ft.) elev.; 20 May 1997; Kiew RK 4464 (SAN) • Pensiangan, Pensiangan Utara Sub District, Kampung Pun Batu, Bukit Pun Batu; 04°47′30″N, 116°11′33″E; 609.6 m (2000 ft.) elev.; 24 October 1996; Lim S. P. et al., LSP 1522 (SAN) • Sipitang, Mile 22, Masapol Forest Reserve; 05°10′29″N, 117°09′13″E; 60.96 m (200 ft.) elev.; 20 March 1966; Francis Sadau SAN 50333 (SAN)• Sipitang, Ulu Meligan Forest Reserve, South-East Meligan Forest Reserve, 04°34′26″N, 115°37′22″E; 1570 m elev.; 9 April 2002; Lim S. P., Postar M. & Petrus B., SAN 145430 (SAN) • Tambunan, Rafflesia Forest Reserve, trail behind the arboretum garden, lower montane forest; 05°46′42″N, 116°20′28″E; 1249 m elev.; 13 May 2011; Suzana et al., SAN 153703 (SAN) – **Pantai Barat** • Ranau, Mount Kinabalu, Dallas, [06°05′30″N, 116°32′45″E]; 1524m elev.; 25 October 1931; Clemens & Clemens 26820 (L) • same locality; 1524 m elev.; 3 March 1932; Clemens & Clemens 29133 (L) • Ranau, Sungai Pandiruan west of Kg. Pinawantai, [06°09′44″N, 116°45′06″E]; 548.64 m elev.; 10 May 1973; G. Shea & Aban, SAN 76893 (SAN) • Ranau, Penibukan (Bahandaoi), Sungai Tahubang, Forest; [06°00′15″N, 116°33′00.0″E]; 1000 m elev.; 11 March 1970; Nooteboom & Aban HP 1544 (SAN) – **Kudat** • Banggi Island, Sabor; [07°13′59″N, 117°13′04″E]; 121.92 m (400 ft.) elev.; 27 August 1964; Ampuria SAN 42149 (SAN); about 1 ½ miles south-east of Kampung Bawing on Bengkoka Peninsula, [06°35′03″N, 117°01′06″E; 60.96 m (200 ft.) elev.; 12 September 1972]; G. Shea & Minjulu SAN 76095 (SAN) – **Sandakan** • Beluran, Bidu-bidu Forest Reserve, Bangau-bangau River, along the Bangau-Bangau River; 05°49′17.2″N, 117°22′19″E; 27 March 2009; Suzana et al., SAN 150035 (SAN) • Beluran, Botitian Forest Reserve, primary forest, 06°00′51″N, 117°19′39″E; 44 m elev.; 21 February 2014; Nur Adillah et al., SAN 156339 (SAN) • same locality; 55 m elev.; 21 February 2014; Nur Adillah, Aloysius & Tawadong SAN 156328 (SAN) • Beluran, Bukit Lumisir, primary forest; 05°40′38″N, 117°11′48″E; 2 February 1982; Abd. Rahim et al., SAN 92968 (SAN) • Beluran, Karamuak, Mount Tawai Forest Reserve, primary forest, hill side; 05°33′38″N, 117°08′58″E; 137.16 m (450 ft.) elev.; 27 July 1978; Diwol S. & Alexius M. SAN 88687 (SAN) • Beluran, Sapi Forest Reserve, Sungai Munyed, logged over area; 05°44′05″N, 117°24′09″E; 14 March 1975; Leopold M. SAN 81469 (SAN) • Beluran, Sugut, 4 miles South of Gunong Mabuak; 06°29′17″N, 117°07′47″E; 16 October 1975; P. F. Cockburn SAN 82520 (SAN) • Kinabatangan, Penangah Forest Reserve, step of hill; 05°01′45″N, 116°43′14″E; 27 April 1987; Joseph & Donggop SAN 119085 (SAN); Sepilok Forest Reserve, Mangrove Trail, lowland dipterorcarp forest; 05°49′36″N, 117°57′04″E; 60 m elev.; 6 September 2006; Diwol S. et al., SAN 110746 (K, L, KEP, SAN) • Kinabatangan, Sungai Imbak Forest Reserve, mixed dipterocarp forest across the Sungai Imbak, NE of base camp; 05°06′17″N, 117°02′18″E; 9 June 2000; J. T. Pereira, R. Nilus, Sidkan A., Postar M. et al., JTP 788 (SAN) • Kinabatangan,

Tabin Wildlife Reserve, 200m south of Kuala Burong, limestone hill; 05°50′N, 116°15′E; 40 m elev.; 26 October 2000; A. D. Poulsen, Ruth Kiew, Hj. Suleiman, Johan & Yesri, ADP 1707 (AAU, BORH, K, KEP, SAN) • Sandakan, Gomantong; [05°31′52″N, 118°04′17″E]; 152.4 m (500 ft.) elev.; 14 February 1960; W. Meijer SAN 20758 (SAN) • Sandakan, Kabili Forest Reserve, Bird Trail, ca. 500 m behind the Orang Utan Rehabilitation Centre Office; 04°35′03″N, 116°54′20″E; 15 April 2014; Suzana et al., SAN 156145 (SAN) • Sandakan, Kebun Cina; 05°51′04″N, 118°03′47″E; 21 May 1990; W. Meijer SAN 111233 (SAN) • Sandakan, Labuk Road, Labuk Road Mile 45, in primary forest; [05°41′57″N, 117°36′12″E]; 16 October 1965; A. Kanis SAN 53906 (SAN) • same locality; 11 January 1965; J. Singh SAN 48413 (SAN) • Sandakan, Segaliud Lokan, Labuk Road, Mile 45, Labuk Road; [06°N, 117°E]; 30.48 m (100 ft) elev.; 24 July 1964; W. Meijer SAN 44011 (SAN) • Sandakan, Sepilok Forest Reserve, 14 miles west of Sandakan; 06°04′00″N, 116°27′00″E; 21 November 1986; P. C. Welzen 924 (L) • same locality; 4.572 m (15 ft.) m elev.; 13 August 1959, W. Meijer SAN 19732 (SAN) • same locality, along Phenological Trail; 19 December 1990; W. Meijer & Dewol SAN 131740 (L, AA, F, K, SAN) • same locality, along trail to Sepilok Laut; 5 November 1980; Aban G. & M. Chang SAN 92735 (SAN) • same locality, Cpt. 11 Near R.P. 19; 15.24 m (50 ft.) elev.; 6 January 1960; Parick Ping Sam SAN 20605 (SAN) • same locality, Cpt. 14 Sepilok Forest Reserve, primary Dipterocarp forest; 9.144 m (10 ft.) elev.; 22 September 1963; W. Meijer SAN 39605 (SAN) • same locaity; 50 m elev.; 5 June 1981; T. Sato, Diwol S. & Patrick L. SAN 93155 (SAN) • same locality, Jalan Batu 15, Cpt. 12; 24 April 1970; Damin Rokiman SAN 61242 (SAN) • same locality, 24 May 1982, Amin G. SAN 94587 (SAN) • same locality; 17 January 1989; Kessler SAN 118161 (SAN) • same locality; 23 April 1996; A. Hay et al. A.Hay 12149 (SAN) • same locality, on ridge hill; 18.288 m (60 ft.) elev.; 16 April 1977; Kodoh T. SAN 83674 (SAN) • same locality, Sample Plot 18, Compartment 4, in primary low dipterocarp forest; 30.48-60.96 m (100-200 ft.) elev.; 13 October 1965; A. Kanis SAN 53818 (SAN) • Sandakan, same locality, Sample Plot 18, Compartment 4; 30.48-60.96 m (100-200 ft.) elev.; 13 October 1965; A. Kanis SAN 53819 (K, L, SAN) • same locality, Arboretum Sepilok, Arboretum trail; 17 December 1998; Pius G. et al., SAN 142860 (SAN) • Sandakan; 5°52′53″N, 117°56′51E; 27 m elev.; 18 August 2014; Klemme & Markus SAN 157307 (SAN) • Tongod, Imbak Canyon Conservation Area, behind the camp near Sungai Kangkawat, along Sungai Kangkawat; 05°09′31″N, 116°55′35″E; 8 October 2018; Suzana et al., SAN 159599 (SAN) • Tongod, Imbak Valley, eastern of base camp, lowland mixed dipterocarp forest; 05°10′29″N, 117°09′13″E; 76.2 m (250 ft.) elev.; 20 May 2004; Bernados SAN 145186 (SAN) • Tongod, Lamag, Karamuak, Sungai Kunatong; [05°N, 115°45′E]; 91.44 m (300 ft.) elev.; 10 September 1973; Madani SAN 76335 (SAN) • Tongod, Lamag, road trace from Kg Kurat to Karamuak; 05°N, 115°45′E; 26 June 1975; Donggop & Gombio SAN 81753 (SAN) • Tongod, Pinangah, Imbak, Imbak river camp 1; 05°10′29″N, 117°09′13″E; 200 m elev.; 3 July 2000; de Wilde, Tajuddin & Postar SAN 143976 (K, NSW, SAN) • Tongod, Pinangah, Ulu Sungai Melikop, Mile 5 Lobou Road; 04°45′N, 116°30′E; 31 May 1985; Diwol & Langkop SAN 109297 (SAN) • Tongod, Sungai Imbak Forest Reserve, Sungai Imbak Scientific expedition, Virgin Jungle Reserve; 05°08′57″N, 117°13′05″E; 132 elev.; 7 April 2014; Suzana et al., SAN 156487 (SAN) • Tongod, Telupid, Labuk-Sugut, 75 m by Telupid airstrip, forest on sand; [05°36′18″N, 117°05′00″E]; 75 m elev.; 19 January 1976; P. F. Stevens et al., PFS 550 (SAN) • Tongod, Telupid, Pinangah Forest Reserve, 4°58′41″N, 116°52′11″E; 13 February 1985; Diwol & Mansus SAN 68007 (SAN) • Tongod, Telupid, Tangkulap, Tawai Forest Reserve, lowland mixed dipterocarp forest; 04°58′41″N, 116°52′11″E; 103.632 m (304 ft.) elev.; 21 October 2004; John B. S. SAN 119245 (SAN) • Tongod, Telupid, VJR Ulu Sungai Sapapayau, at riverbank of Merah River, Lideh Sobal; 5°30′00.0″N, 118°30′00.0″E, 15 October 1985, Lideh S. SAN 109521 (SAN) – **Tawau** • Lahad Datu, Madai-Baturong Forest Reserve, Madai Hill; 04°41′18″N, 118°1′55″E; 1 June 1996; S. P. Lim, R. Kiew & Mail LSP 690 (SAN) • Lahad Datu, Sapagaya VJR, Ultramafic, near rocky stream; 04°58′11″N, 118°05′10″E; 253 m elev.; 16 February 2012; Suzana et al., SAN 151431 (SAN) • Lahad Datu, Silam; [04°57′30″N, 118°10′02″E]; 9.144 m (10 ft.) elev.; 27 September 1963; Agam B. Abdullah SAN 37167 (SAN) • Lahad Datu, Tabin Wildlife Reserve, Lipad Mulvucano Virgin Jungle Reserve; 05°14′30″N, 118°50′16″E; 3-7 November 1998; Fin Borchsenius FB 587 (BORH, SAN) • Lahad Datu, Tabin Wildlife Reserve, near Wildlife Department's Headquarter, in selective mixed dipterocarp forest; 05°51′28″N, 116°58′37″E; 150 m elev.; 24 February 2000; Kjeldsen, Poulsen & Magintan H. K. Kjeldsen 38 (SAN) • Lahad Datu, Ulu-Segama Malua Forest Reserve, KM 79 Compartment 96, beside Bukit BRL; 05°03′10″N, 117°44′54″E; 320 m elev.; 14 February 2012; Suzana et al., SAN 154617 (SAN) • Lahad Datu, Ulu-Segama Malua Forest Reserve, Merisuli VJR, around the cave area, limestone; 05°08′26″N, 118°08′03″E; 186 m elev.; 17 February 2012; Suzana, et al., SAN 151840 (SAN, SAR) • Semporna, Mile ¾ Agri. Station, primary forest; 05°18′28″N, 117°04′23″E; 10 June 1962, J. Singh SAN 26319 (K, L, SAN) • Tawau, Bukit Gemuk Forest Reserve, rocky forest; 04°18′00″N, 117°52′00″E; 20 October 1985; Madani & Sigin SAN 111556 (SAN) • same locality; 28 June 2006; Julia S. et al., SAN 147143 (SAR, KEP) • Semporna, Segarong Forest Reserve, limestone hill; [04°34′05″N, 118°25′24″E]; 60 m elev.; 26 August 1938; Keith, H. G. Keith 9419 (L) • Tawau, Kalabakan, Gunung Rara, Trail to Cave Batu Timbang, mixed Dipterocarp forest; 04°58′31″N, 117°08′55″E; 237 m elev.; 12 March 2015; Suzana et al., SAN 157129 (KEP, SAN) • Tawau, Lembah Danum, Borneo Rainforest Lodge, gully near Lembah Danum; 05°01′10″N, 117°44′48″E; 1 March

1992; E. J. F. Campbell Gasis EG 316 (SAN) • Tawau, Mount Wullersdorf Forest Reserve, around the Teck Guan Quary, limestone; 04°24′03″N, 118°00′53″E; 91 m elev.; date unknown; Nadiah et al., SAN 149140 (K , KEP, SAN) • Tawau, Tawau Hills Park, along the trail to Gelas Hill Trail; 04°23′N, 117°53′E; 272 m elev.; 29 June 2006; Suzana, S. with Joel D., & Cornelia L. SAN 147276 (KEP, SAN, SAR).

Identification. This species is distinguished by the leaf blade with strongly impressed (Nicolson 1969). The spathe is caducous, a day post anthesis (Chai and Wong 2019).

Distribution and ecology. Widespread in Sabah. Primary or secondary forests in ravines or damp places. It rarely occurs over 1500 m elev. but has been reported at "7000 feet" (over 2000 m elev.) on Mt. Kinabalu (Nicolson 1969).

Alocasia cuprea (C.Koch & Bouché) C.Koch

Figure 2A

Material examined. MALAYSIA – **Pendalaman** • Sipitang, Long Hoare & Pengiran Mio, hill across river to E. of village, 04°26′04″N, 115°44′50″E; 13 September 2000; A. D. 295 (SNP) • Tenom, Rafflesia site, TBC, Mosolog river, trail to Rafflesia site; 05°17′04″N, 116°01′38″E; 640 m elev.; 18 February 2003, Yabainus J., Kinahim S., & Joseph KNP 17802 (SNP) • Tenom, Ulu Senagang, TBC, Ulu Senagang, Trail to Rafflesia Site; 05°20′32″N, 116°01′53″E; 680 m elev.; 18 February 2003; Yabainus J., Kinahim S., & Joseph, SP 17818 (SNP) – **Pantai Barat** • Ranau, Kampung Bundu Tuhan, Kampung Himbaan, Telupak; 05°57′26″N, 116°32′45″E; 8 January 1994; Doinis S., 689 (SNP) • Ranau, Kinabalu Park, Expidisi Mt. Tombuyukon, Wuluh Camp; 06°05′30″N, 116°32′45″E; 400-500 m elev.; 9 October 2009, Yabainus J. KNP 17339 (SNP) • Ranau, Mount Kinabalu, Marai Parai, 06°05′30″N, 116°32′45″E; 610 m elev.; 1985; Argent G. C. G. Argent, s.n. (K) • same locality, cultivated in glasshouse at Royal Botanic Gardens; Sydney; 610 n elev; September 1996-February 1998; C. Herscovitch s.n. (K, KEP L, SAN) – **Sandakan** • Kinabatangan, Maliau Basin, Gunung Rara Forest Reserve, 2.5 KM above Maliau Falls; 04°30′00″N, 116°45′00″E; 14 April 1996; A.Hay et al., A.Hay 12092 (SAN) – **Tawau** • Tawau, Ephilstone Province; [04°18′00″N, 117°54′00″E]; October 1922 to March 1923; Elmer A. D. E. Elmer 20471 (L) • Tawau, Tawau Hills Park, lowland garden; 04°24′04″N, 117°53′24″E; 250 m elv.; 18 January 2007; Yabainus J., KNP 13338 (SNP).

Identification. Leaves of *A. cuprea* are subtended by two marcescent reddish brown cataphylls. The leaf blades are distinctive with bullate between the main veins, adaxially glossy bronze-green but abaxially deep purple. *Alocasia cuprea* has long been considered as one of the most spectacular and bizarre foliage plants in the genus and is a parent of several interspecific horticultural hybrids (Hay 1998).

Distribution and ecology. Endemic to Sabah. On slopes in rain forest, over a wide variety of substrates including ultramafics and sandstone, ca. 40–1500 m elev.

Alocasia longiloba Miq.

Material examined. MALAYSIA – **Pantai Barat** • Ranau, Mount Kinabalu; 06°05′30″N, 116°32′45″E; 3 June 1981; Buxton 352 (M) – **Sandakan** • Sandakan, Sepilok Forest Reserve, cultivated at Royal Botanic Gardens, Sydney. Acc. No. 960519, 05°19′N, 118°45′E; 23 April 1996; A. Hay 12153 (K, KEP, L, SAN) • Sandakan, Sepilok Kabili Forest Reserve, Kerangas forest; 04°26′56″N, 117°10′26″E; 156 m elev.; 12 October 2018; Khoo & Martin SAN 159607 (SAN) – **Tawau** • Lahad Datu, Sungai Kapur; 05°20′04″N, 118°56′69″E; 72 m elev.; 20 March 2012; Sugau J. B. & Markus G. SAN 154915 (SAN).

Identification. Hay (1998) treats *A. longiloba* as an orchospecies (species which exhibits a complex pattern of variation among its members but is not separable into distinct subspecific groups of several peak variants). The complex is distinguished by a triangular leaf blade (two to three times as long as broad). The leaf blade may be plain mid-green throughout to adaxially dark green and abaxially rich purple, often adaxially with the major venation white to pale grey-green.

Distribution and ecology. In perhumid tropical forest and regrowth understorey, on boulders in forest and on exposed cliffs and ravines at low to medium elevation.

Alocasia macrorrhizos (L.) G.Don

Material examined. MALAYSIA – **Pedalaman** • Tenom, Sungai Rayoh Forest Reserve, 5°11′40″N, 115°52′50″E; 53 m elev.; 8 March 2018; Alviana et al. SAN 158800 (SAN) – **Sandakan** • Sandakan, Kg. Pukat, Leila Road; [05°49′52″N, 118°05′10″E]; 6 January 1950; Kadir Abdul A 2698 (SAN).

Identification. *Alocasia macrorrhizos* is a cultigen (Hay 1998) and is not known from wild. It has evidently been distributed widely in tropical Asia in prehistoric times as a subsistence crop and is now pantropical by introduction as an ornamental (Hay 1998). The species is a massive pachycaul with the stem is either decumbent or erect. The leaf blades are ovato-sagittate, bluntly triangular in general outline, held more or less erect with the posterior lobes ca. ⅓–½ the length of the anterior lobe. Inflorescences are paired among the leaf bases.

Distribution and ecology. Widespread in Sabah. Roadsides, waste places, gardens, mostly in wet sites at low to medium elevation. It is highly doubtfully native except perhaps in the far east of Sabah, elsewhere it is certainly a long-established ruderal escape.

Alocasia melo A.Hay, P.C.Boyce & K.M.Wong

Figure 2B

Material examined. MALAYSIA – **Sandakan** • Beluran, Porog, westside of Bidu-Bidu Hills near Kubar Labuk; [05°49′48″N, 117°14′29″E]; 152.4 m (500 ft.) elev.; 1

Figure 2. *Alocasia* in Sabah. **A.** *Alocasia cuprea*. **B.** *Alocasia melo*. **C.** *Alocasia pangeran*. **D.** *Alocasia principiculus*. **E.** *Alocasia reginula*. **F.** *Alocasia robusta* (inflorescences post anthesis). **G.** *Alocasia sarawakensis* (inflorescence). **H.** *Alocasia wongii*.

June 1964; W. Meijer SAN 41241 (SAN) • Tongod, Gunung Tingkar; 05°18′00″N, 117°07′45″E; 6 April 1996, A. Hay, Lim & Ahmad A. Hay 12001 (NSW, SAN) • Tongod, Pinangah Forest Reserve; Dewol Sundaling et al., 04°44′50″N, 116°36′53″E; 200 m elev.; 8 December 2004; SAN 113650 (SAN).

Identification. Highly ornamental. The finely and strongly rugose adaxial leaf surface of *A. melo* seems unique in the genus (Hay 1998).

Distribution and ecology. Endemic to Sabah. Rainforest on ultramafic rock, in rock crevices and on thin soil along steep banks of fast-flowing streams, at elevations of 120–400 m elev.

Alocasia pangeran A.Hay

Figure 2C

Material examined. MALAYSIA – **Sandakan** • Lahad Datu, Madai Caves, Cult. RBG Sydney, Acc. No. 960509; 400 m elev.; Hay et al. 12175 (isotype SAN).

Identification. *Alocasia pangeran* is distinguished from *A. princeps* W.Bull by its calcicolous lithophytic habit, smaller stature, more slender inflorescence, relatively longer lower spathe and lax interstice. *Alocasia pangeran* coexists with the terrestrial *A. wongii* A.Hay and the lithophytic *A. puteri* A.Hay at Madai Caves (Hay 1998).

Distribution and ecology. Endemic to Sabah, known only from Madai Caves. In soil and humus pockets on limestone outcrops and boulders in mixed lowland dipterocarp forest at ca. 400 m elev.

Alocasia princeps W.Bull

Material examined. MALAYSIA – **Pedalaman** • Sipitang, Upper Sungai Miau near Mount Muruk Miau, Lower Montane Oak–Chestnut Forest; 04°21′57″N, 115°50′01″E; 1300 m elev.; 13 April 2000; S. P. Lim, Postar & Markus SAN 143225 (SAN) – **Pantai Barat** • Penampang, Moyog, W slopes of Crocker Range; 05°50′N, 116°15′E; 1000 m elev.; 26 September 1981; T. B. Croat 53102 (MO, SAR) • Ranau, Mount Kinabalu, Plants of B.N. Penibukan; [06°N, 116°35′E]; 1219 m elev.; 11 March 1933; Clemens & Clemens 32095 (L) • Ranau, About 3 miles NW of Kampung Pinawantai; [06°11′27″N, 116°44′54″E; 1371.6 m (4500 ft.) elev.; 1 May 1973; G. Shea & Aban SAN 76856 (SAN) – **Kudat** • Pulau Balambangan, limestone hill slope; 04°34′37″N, 118°15′05″E; 6.096 m elev.; 9 April 1977; collector unknown SAN 86716 (SAN) – **Sandakan** • Beluran, Nangoh, on hill top; 05°59′10″N, 117°16′33″E; 5 December 1983; Rahim Nawi SAN 101765 (SAN) • Kinabatangan, Tibau Forest Station, cultivated in Glasshouse at Royal Botanic Gardens, Sydney; 04°30′N, 116°45′E; 350 m elev.; 21 April 1996; wild collection, A. Hay 12140 (K, KEP, L, SAN, US) • Kinabatangan, Gua Batu Puteh, wild collection, a duplicate of NSW 425717, ACC 95035; 04°38′53″N, 116°36′54″E; date unknown, A. Hay 10015 (K, L, SAN).

Identification. *Alocasia princeps* is distinguished by the leaf blade leathery but not subsucculent that is dark green and shining at least when young (Hay 1998).

Distribution and ecology. Widespread in Sabah. In rain forest generally on well-drained slopes and ridgetops, on a variety of substrates including basalt and limestone, from more or less sea level to ca. 1200 m elev.

Alocasia principiculus A.Hay

Figure 2D

Material examined. MALAYSIA – **Sandakan** • Gomantong Cave; [05°31′52″N, 118°04′17″E]; 15.24 m (50 ft.) elev.; 27 September 1948; Austin Cuadra A. 1489 (isotype, SAN).

Identification. *Alocasia principiculus* differs from all the *A. princeps* complex in its small overall size, grey-green, thin, leathery leaves, relatively long peduncles, and the male zone is held entirely within the lower spathe chamber (Hay 1998).

Distribution and ecology. Endemic to Borneo: Sabah and East Kalimantan. Confined to limestone; growing in soil pockets on limestone outcrops and boulders under mixed lowland dipterocarp forest, at ca. 600 m elev.

Alocasia puteri A.Hay

Material examined. MALAYSIA – **Pedalaman** • Kunak, Madai Caves; 04°43′45″N, 118°08′E; 400 m elev.; 25 April 1996, A. Hay 12178 (K, L).

Identification. *Alocasia puteri* occurs together with and in the same habitat as *A. pangeran* and can be differentiated by the bright green leaf colour (unusual for this species group), the broader posterior lobes, more upright petiole, a tendency for the leaves to be peltate in subadult plants, and by lacking a sterile interstice of the appendix (Hay 1998).

Distribution and ecology. Endemic to Sabah. Known only from Madai Caves where it is uncommon. In soil pockets on limestone outcrops and boulders in mixed lowland dipterocarp forest, at ca. 400 m elev.

Alocasia reginula A.Hay

Figure 2E

Material examined. MALAYSIA – **Tawau** • Lahad Datu, Tabin Wildlife Reserve KM 16 on road Headquarters area; 05°11′28″N, 118°37′06″E; 26 September 1998; F. Borchsenius 542 (SAN, BORH) • Lahad Datu, Tabin Wildlife Reserve Road to core Area, km 15.9 along logging area to the N; 05°14′30″N, 118°50′16″E; 29 October 1998; F. Borchsenius 577 (BORH, SAN) • same locality; 91.44 m (300 ft.) elev.; 25 August 2000; Pius G. Dauni, S. Tawadong T. SAN 143438 (AAU, K, NSW).

Identification. *Alocasia reginula* was described from cultivated material of unknown origin (Hay 1998). Since then, it has been discovered to be endemic to Tabin Wildlife Reserve. The species is distinguished by the leaf blade thickly coriaceous, almost completely peltate save for a shallow retuse notch between the tips of the connate posterior lobes. The adaxial surface of the leaf blade is

very dark matt green and the abaxial is paler and flushed purple (Hay 1998).

Distribution and ecology. Endemic to Sabah, known only from Tabin Wildlife Reserve. Heavily shaded karst cliffs.

Alocasia robusta M.Hotta

Figure 2F

Material examined. MALAYSIA – **Pedalaman** • Keningau, TBC, Mile 21; 05°08′37″N, 116°17′20″E; 850 m elev.; 22 February 2003; Kinahim et al. SP 17856 (SNP) • Sipitang, Chi Hin waterfall; 05°02′30″N, 115°50′39″E; 412 m elev.; 23 March 1999; R. Kiew & Ali I., Ruth Kiew 4647 (SAN) – **Pantai Barat** • Ranau, Mount Tombuyukon, Sub-station Monggis, summit trail to Mount Tombuyukon; 06°12′50″N, 116°39′20″E; 400 m elev.; 13 December 2009; Yabainus J. KNP 18147 (SNP) – **Tawau** • Lahad Datu, Tabin Wildlife Reserve; 05°12′N, 118°38′E; 150 m elev.; 4 July 2000; Kjeldsen K. H. Kjeldsen 186 (SAN) • Tawau, Tawau Hills Park; 04°59′30″N, 117°11′00″E; 22 April 1992; Berhaman et al. SAN 134531 (SAN).

Identification. *Alocasia robusta* is a gigantic arborescent herb with leaf blades strikingly glaucous on the underside. This species resembles *A. macrorrhizos*, with a rather similar subtriangular ovato-sagittate leaf outline but can be distinguished by the posterior costae with tissue extending into the sinus and the glaucous abaxial side to the blade. The seedlings, even when quite large, have peltate leaves with the undersides glaucous and the whole glabrous (cf. *A. sarawakensis*). The inflorescences are very different from those of *A. macrorrhizos*, both in their clustered arrangement, and the thick marcescent/deliquescent cataphylls (bits of which often adhere to the open spathe), the ivory horizontally red-marked lower spathe and the thick greyish to purplish limb (Hay 1998).

Distribution and ecology. Widespread. Wet but well-drained open disturbed places, roadside, plantations, riverbanks, land slides, and canopy gaps in lowland to lower montane forest.

Alocasia sarawakensis M.Hotta

Figure 2G

Material examined. MALAYSIA – **Pedalaman** • Beluran, Ulu Tungud Forest Reserve, Sungai Keberibi; 05°51′28″N, 116°58′37″E; 411 m elev.; 23 Juy 2005; Joanes U., Julia S., Pius G., Kuntil L., Entol M. & Ajirin M. SAN 146894 (SAN) • Tambunan, Kampung Tondulu, Road to Kampung Tondulu, 05°41′06″N, 116°20′08″E; 670 m elev.; 16 October 1999; P. C. Boyce & J. Linton, P. C. Boyce 1413 (SNP) – **Sandakan** • Kinabatangan Besar, Korin Timber Camp; 28 October 1948; Cuadra A. 2144 (SAN) – **Tawau** • Lahad Datu, Danum Valley Conservation area, Mount Tribulation; 04°50′17″N, 117°39′51″E; 387 m elev.; 26 August 2016; Sugau J. B., Jeisin, M. & Postar, M. SAN 158179 (SAN) • Lahad Datu, Tabin Wildlife Reserve, Wildlife Department's Headquarter, West to Lipad Mud Volcano; 05°11′″N, 118°30′E; 150 m elev.; 23 February 2000; Kjeldsen K.H. Kjeldsen 30 (AAU, SAN) • same locality; 150 m elev.; 8 March 2000; Kjeldsen K.H. Kjeldsen 85 (AAU, BORH, KEP, SAN) • Semporna, Mapat R., Timbun Mata Forest Reserve; 3.6576 m (12 ft.) elev.; 8 August 1937; Keith A 7419 (SAN) • Tawau, Mount Lucia, Expidisi Mount Lucia, Morutai River, along stream; 04°28′11″N, 117°56′22″E; 720 m elev.; 6 July 2005; Yabainus J. SP 10774 (SNP).

Identification. *Alocasia sarawakensis* is easily distinguished from *A. robusta* and *A. macrorrhizos*, which sometimes all occur together and resemble each other in the very large broad leaves and preference for open habitats, by the very prominent venation on the abaxial side of the leaf blade, forming well defined interprimary collective veins. It can be distinguished further from *A. robusta* by having the posterior costae naked in the sinus and the abaxial side of the leaf blade pubescent and not glaucous (Hay 1998).

Distribution and ecology. Widespread. Common in open swampy places; often seen in roadside ditches; encountered in swampy places in forest as a hairy juvenile; from sea level to ca. 1200 m elev.

Alocasia scabriuscula N.E.Br.

Material examined. MALAYSIA – **Pedalaman** • Nabawan, Pensiangan Forest, Sungai Kerilin; 04°31′07″N, 116°19′39″E; 22 July 2016; Ubaldus & Baraham SAN 158024 (SAN) – **Pantai Barat** • Penampang, Moyog along the road between Kota Kinabalu and Tambunan, 21 miles SE of Kota Kinabalu, W slopes of Crocker Range; 05°50′N, 116°14′E; 460 m elev.; 26 September 1981; T. B. Croat 53114 (MO, SAR) • Ranau, Kundasang, Kinabalu above Sosopodon; [06°00′15″N, 116°33′00″E]; 1524 m elev.; 2 February 1962; W. Meijer SAN 29021 (SAN) – **Sandakan** • Kinabatangan, Kalabakan Jungle Reserve, 04°27′01″N, 116°59′27″E; 300 m elev.; 7 April 1996; A. Hay 12006 (K, KEP, L, SAN) • Kinabatangan, Sukau, WWFM small plots; 05°31′37″N, 118°18′16″E; date unknown; G. Bassford & Reza A. GB 191 (SAR) • same locality; date unknown; G. Bassford & Reza A. GB 191 (SAR) • Kinabatangan, Maliau Falls, Gunung Rara Forest Reserve; 04°30′00″N, 116°45′00″E; 9 April 1996; A. Hay 12045 (K, KEP, L, SAN) • Sandakan, Sepilok Forest Reserve; 05°10′29″N, 117°09′13″E; 11 August 1994; G. Antok SAN 141501 (SAN) • Sandakan, Sepilok Sungai Seguntor corner; 05°49′36″N, 117°57′04″E; 20 July 1990; J. Kulip & W. Meijer SAN 130939 (SAN) – **Tawau** • Lahad Datu, Ulu Sungai Danum; 05°01′36″N, 117°46′15″E; 3 July 1976; B. C. Stone et al. SAN 85307 (SAN) • Lahad Datu, Danum Valley Field Centre, Orchid Trail to East trail; 04°40′00″N, 117°29′00″E; 150 m elev.; 4 August 1998; Magintan & Raya Magintan 573 (AAU, SAN) • Lahad Datu, Baturong; 04°37′25″N, 118°45′29″E; 28 August 1999; R. Kiew RK 4794 (SING) • same locality, 28 August 1999, R. Kiew RK 4798 (SING).

Identification. *Alocasia scabriuscula* is a highly variable

species. Typical forms have ovatsagittate and thick, dark to mid grey-green leaves with the inner sides of the posterior costae very narrowly oblanceolate. The leaf blade is from distinctly though rather thinly leathery, to blades almost 5 mm thick and virtually succulent (Hay 1998).

Distribution and ecology. Widespread in Sabah. Lowland forest to hill forest to ca. 1200 alt., often in disturbed areas, in swampy to well-drained sites, riverbanks, occasional on roadsides and in plantations.

Alocasia wongii A.Hay

Figure 2H

Material examined. MALAYSIA – **Pedalaman** • Keningau, Sepulut, growing on rocky place; 06°20′N, 116° 40′E; 3 June 1985; Aban G. et al. SAN 107969 (SAN) • Keningau, Tambunan, Primary forest, flatland; 04°33′59″N, 116°58′01″E; 19 October 1983; Amin & Patrick SAN 69048 (SAN) • Sipitang, Ganui Forest Reserve, secondary forest; 05°00′25″N, 115°41′32″E; 380 m elev.; 17 March 2011; Pereira, J. T. & Jamirus, J. SAN 153520 (SAN) – **Sandakan** • Beluran, Sungai Kolayok, on ridge hill; 05°53′50″N, 117°39′48″E; 28 August 2018; Amin & Mohamid SAN 111046 (SAN) • Beluran, Ulu Tungud Forest reserve; 05°51′28″N, 116°58′37″E; 370 m elev.; 23 July 2005; Joanes et al. SAN 146876 (SAN) • Kinabatangan, Bukit Garam; 05°29′13″N, 117°51′19″E, 11 November 2019; Reza A. RA 30 (K, KEP, L, SAN, SAR) • Kinabatangan, Kota Kinabatangan, 05°26′02″N, 117°52′01″E; 3 April 1992; Dewol, Francis & Dauni SAN 132484 (SAN) • Sandakan, Gomantong Caves, 05°31′33″N, 118°04′24″E; 31 October 1968; S. Kokawa & Mitsuru Hotta, Kokawa & Hotta 576 (L) • Sandakan, Lamag, Sungai Pin; 05°23′28″N, 117°52′53″E; 25 November 1978; Dewol & Harun SAN 89905 (SAN) • Sandakan, Sepilok Forest Reserve, understory primary forest at Jalan Batu 15; 05°49′36″N, 117°57′04″E; 11 December 1973; Aban G. SAN 76687 (SAN) • Sandakan, Ulu Dusun Agriculture Research Station; 05°47′11″N, 117°46′06″E; 100 m elev.; 29 August 1989; Yap S. K. & Khairuddin SAN 106089 (SAN) • same locality, 10 August 1977; S. Lantoh SAN 87802 (SAN) • Tongod, Pinangah; 05°18′40″N, 117°06′10″E; 4 February 1983; Dewol & Mansus SAN 67396 (SAN) • Tongod, ridge of Bukit Mengalas-Kalas, disturbed Dipterocarp forest; 05°30′25″N, 116°52′15″E; 68 m elev.; 12 March 1981; Dewol S. SAN 93149 (SAN) • Tongod, Ulu Sungai Pinangah, undulating land; 05°23′27″N, 117°52′52″E; 22 October 1984; Amin & Ismail SAN 107302 (SAN) – **TAWAU** • Kunak, Madai-Baturong Forest Reserve, Madai, Near Sungai Madai; 04°44′30″N, 118°07′55″E; 25 December 1993; Majawat & Kumin SAN 138329 (SAN) • Lahad Datu, Selangan Forest Reserve; 04°34′20″N, 118°30′05″E; 9.144 m (30 ft.) elev.; 13 August 1948; H. G. Keith A 1519 (SAN) • Lahad Datu, Silam, hillside; 04°59′00″N, 118°13′10″E; 23 October 2007; Pius et al. SAN 149373 (SAN) • Lahad Datu, Tabin Wildlife Reserve, near Wildlife Department's Headquarter; 05°18′N, 118°44′E; 150 m elev.; 22 February 2000; K. H. Kjeldsen K. H. Kjeldsen 23 (SAN) • same locality; 150 m elev.; 1 March 2000, K. H. Kjeldsen K. H. Kjeldsen 58 (AAU, SAN) • Lahad Datu, Tabin Wildlife Reserve, trail to Lipad Mud Volcano; 05°14′30″N, 118°50′16″E; 28 May 1998; F. Borchsenius FB 506 (BORH, SAN) • Semporna, Bohey Dulang Island, Taman Marin Tun Sakaran; 04°35′50″N, 118°47′11″E; 185 m elev.; 2 August 2009; Kinahim et al. SP 16501 (SNP) • Semporna, Selangan Forest Reserve, in forest; 04°34′20″N, 118°30′05″E; 6.096 m (20 ft.) elev.; 17 July 1938; H. G. Keith 9286 (SAN) • Tawau, Taman Bukit Tawau, trail to Hot Spring; 04°25′41″N, 117°53′23″E; 200 m elev.; 26 January 2000; Fauzi Laimin SP 14785 (SNP) • Tawau, TBC, route to Dipterocapaceae Plot 1 A; 459 m elev.; 7 June 2005; Dolois et al. SP 10176 (SNP) • Tawau, TBC, Trail Taman Haiwan; 300 m elev.; 10 June 2003; Yabainus et al. SP 17771 (SNP) • Tawau, TBT, Ulu Sungai TBT, Trail Utama Barat; 300 m elev.; 19 May 2003, Yabainus et al. SP 17903 (SNP) • Tawau, Ulu Kalumpang Forest Reserve; 04°35′13″N, 117°57′42″E; 400 m elev.; 12 October 1996; Diwol Sundaling SAN 135224 (SAN).

Identification. A fairly well-defined and geographically coherent element distinguished from *A. princeps* s.s. by the generally slenderer stature, the petiole with markings distinctive in the complex but almost identical to those typically found in *A. longiloba* 'denudata'. The spathes are suffused a rather dirty purpe-brown or violet-brown, with the limb somewhat darker than the lower spathe. The lower spathe in flower and the fruiting spathes are less rotund, and the limb shorter and slenderer than in *A. princeps*. The spadix is slenderer with the pistils and synandrodia rather loosely arranged and the male zone is less exserted (Hay 1998).

Distribution and ecology. Endemic to Sabah. Eastern, southwestern, and northeastern Sabah. Terrestrial in lowland mixed dipterocarp forest on well-drained and occasionally inundated sites at low elevation.

Amorphophallus hottae Bogner & Hett.

Figure 3A

Material examined. MALAYSIA – **Pedalaman** • Tenom, along Sungai Malatut, about 15 km north of Tenom; 300–450 m elev.; Dec. 22, 1968; Kokawa & Hotta 2527 (holo KYO, iso K).

Identification. *Amorphophallus hottae* is distinctive for its narrow spathe combined and its long, excerted, thin spadix (Bogner and Hetterscheid 1992).

Distribution and ecology. Widely distributed in Tenom, Ranau, and Crocker Range National Park, Sabah. Limestone forest; grows in pockets of limestone.

Amorphophallus lambii Mayo & Widjaja

Figure 3B

Material examined. MALAYSIA – **Pedalaman** • Tenom; 600 m elev.; 11 June 1980; A. Lamb s.n. (SAN) • locality unknown; 4 May 1984; A. Lamb s.n. (SAN).

Identification. *Amorphophallus lambii* has a rather

Figure 3. *Amorphophallus* and *Bucephalandra* in Sabah. **A.** *Amorphophallus hottae* (inflorescence). **B.** *Amorphophallus lambii* (inflorescence) C. *Amorphophallus rugosus* (inflorescence). **D.** *Amorphophallus tinekeae* (inflorescence) **E.** *Amorphophallus venustus* (inflorescence). **F.** *Amorphophallus venustus*. **G.** *Bucephalandra danumensis*. **H.** *Bucephalandra ultramafica*. **A-C, E.** @ Wilbert Hetterscheid. **D.** @ Mike Lo.

long flowering period in cultivation which may last over a week. It produces a distinct urine scent. The berries are eaten by Bulbuls (*Pycnonotus zeylanicus* Gmelin) as soon as they become ripe and turn red. Infructescences are therefore always found to contain only orange, slightly unripe berries and a naked upper infructescence axis (Hetterscheid and Ittenbach 1996).

Distribution and ecology. Endemic to Sabah. Found in Tenom, Ranau, and Crocker Range National Park. In shaded conditions in rubber plantations, cleared land, along riverbanks and in relict fragments of lowland rainforest, on rich alluvial soils, ca. 200 m elev.

Amorphophallus rugosus Hett. & A.L.Lamb

Figure 3C

Material examined. MALAYSIA – **Pedalaman** • Tambunan/Keningan District-boundary, Ulu Apin Apin, in colluvial soil, on slope of sanstone ridge, cool shaded habitat; ca. 700 m elev.; i-1993; Lamb & Surat ALFS 625 (holo L).

Identification. *Amorphophallus rugosus* is morphologically similar to *A. costatus* but can be differentiated by the much longer peduncle and larger proportions in general (Hetterscheid 1994).

Distribution and ecology. Endemic to Sabah. Known only from the type collection from Ulu Apin Apin, Tambunan-Keningau. *Amorphophallus rugosus* can be found growing in traditional orchards, rubber farms, secondary and mixed dipterocarp forest. In colluvial soil, on slope of sandstone ridge, cool shaded habitat, ca. 700 m. elev.

Amorphophallus tinekeae Hett. & A.Vogel

Figure 3D

Material examined. MALAYSIA – Location unknown; cult. in Leiden Botanical Garden, original collection A. Vogel 950012; 5 April 1997; Hetterscheid H.A.M. 477 (holo L, spirit collection).

Identification. *Amorphophallus tinekeae* is a member of a group of exclusively Bornean species and most closely resembles *A. borneensis* Engl. & Gehrm., from which it differs by having a consistently short peduncle, strongly zygomorphic stigmas, and a rather narrow appendix (Hetterscheid and van der Ham 2001).

Distribution and ecology. Endemic to Sabah. Known from the type locality in Gomantong Caves on karst limestone.

Amorphophallus venustus Hett., A.Hay & Mood

Figure 3E, F

Material examined. MALAYSIA – **Sandakan** • Maliau Basin, Gunung Rara Forest Reserve, 2.5 km above main Maliau Falls, in mixed dipterocarp forest over sandstone; ca. 530 m elev.; Herscovitch s,n. (holo NWS, spirit coll.).

Identification. *Amorphophallus venustus* is doubtless a close ally of *A. manta* Hett. & Ittenbach (Sumatra), *A. bufo* Ridl. (W. Malaysia), and *A. sparsiflorus* Hook.f. (W. Malaysia), with which it shares the unique linguiform spathe with its peculiar strongly dorsally curved margin above the base. *Amorphophallus venustus* differs mostly from all of these species by the silver variegation along the main veins of the leaflets, the presence of verrucae on the appendix, and the appendix itself being quite thin and creamish (vs. dark glossy purple and inflated in the other species). The peculiar colour and variegation of the leaflets of *A. venustus* is only shared wih *A. pendulus* Bogner & Mayo (Sarawak), a species also closely allied to the species group mentioned above (Hetterscheid and van der Ham 2001).

Distribution and ecology. Endemic to Sabah. Sepilok, Maliau Basin, Gunung Rara mixed dipterocarp forest and sandstone. In secondary forest on sandstone, in deep shade, ca. 450 m elev.

Amydrium medium (Zoll. & Moritzi) Nicolson

Material examined. MALAYSIA – **Pedalaman** • Keningau, Hutan Simpan Trus Madi, lower montane forest; 05°30′21″N, 116°34′47″E; 689 m elev.; 28 October 2011; Pius G. SAN 154012 (SAN) • Keningau, Pisagon, along the riverside; 05°N, 116°15′E; 23 June 1989; Fidilis & Sumbing SAN 127663 (SAN) • Keningau, Pisagon, Growth along the riversides; 05°N, 116°15′E; 16 January 1990; Sumbing J. SAN 128253 (SAN) • Keningau, Ulu Sungai Blassanon KM 22 Jalan Keningau, along the riversides; 04°55′13″N, 116°29′31″E; 11 August 2019; Fidilis K. SAN 128195 (SAN) • Nabawan, Sungai Milian; 04°59′58″N, 116°29′56″E; November 1986; Sumbing J. SAN 118663 (SAN) • Nabawan, Syarikat Undan Sdn Bhd logging area, KM18 Jalan Nabawan/Pandewan; 04°55′13″N, 116°29′31″E; 14 March 1990; Sawan T. SAN 128095 (SAN) • Pensiangan, Kayu Forest Reserve, along the swamp; 25 January 1994; Sumbing J. SAN 136924 (SAN) • Sipitang, Long Pasia, Bukit Dusun; 04°27′34″N, 115°44′53″E; 1200 m elev.; 338.33 m (1110 ft.) elev; 27 January 2003; Dolois et al. SP 18067 (SAN) • Sipitang, Lower Sungai Maga, Riverine Forest; 18 April 2000; S. P. Lim, Postar & Markus SAN 143299 (SAN) • Sipitang, Southern Eastern, Swamp Forest; 5°01′35″N, 115°35′19″E; 95 m elev.; 19 May 1990; W. Meijer SAN 130219 (SAN) • Tambunan, above Kg Sunsuron, hill slope on the trail to Rafflesia Plot; 05°44′38″N, 116°22′45″E; 18 November 1989; Joseph R. & Donggop T. SAN 128641 (SAN) • same locality; 17 November 1989; Joseph R. & Donggop T. SAN 128636 (SAN) • Tambunan, Trusmadi Tambahan 2, Syarikat Tinju, hillside; 05°26′47″N, 116°48′15″E; 19 April 1990; Julius Kuli et al. SAN 130201 (SAN) • Tenom, Bunut; 05°06′39″N, 115°56′56″E; 300 m elev.; 21 November 1968; K. Ogata 11631 (L) • Tenom, Hutan Simpan Mendalom, lowland; 14 August 1993; Sumbing J. SAN 136117 (SAN) • Tenom, Lumaku Forest Reserve, Kampung Ulu Bunut, mixed dipterocarp forest; 05°03′94″N, 117°53′66″E; 800 m elev.; 24 March 2010; Suzana et al. SAN 151464 (SAN) • Tenom, Secondary forest, Agriculture Station; 05°10′54″N, 115°59′23″E; 15 October 1987; W. Meijer SAN 122497 (SAN) • Tenom, Ulu Kelang Forest Reserve, Montane Forest; 05°9′43″N,

115°55′42″E; 18 September 1991; L. Madan et al. SAN 133074 (SAN) – **Pantai Barat** • Kota Belud, above Kg Paka, cultivated area; 06°19′42″N, 116°22′33″E; 15 April 1989; Julius K., SAN 124867 (SAN) • Ranau, Bambangan; 05°58′30″N, 116°38′45″E; 7 April 1988; Amin G. SAN 121562 (SAN) • Ranau, Bukit Hampuan Forest Reserve, Oak–Cchesnut forest; 06°00′30″N, 116°39′31″E; 1364 m elev.; 11 May 2010; Pereira, J. T., Pius, G., et al. SAN 151722 (SAN) • Ranau, Bukit Kulung; 06°01′26″N, 116°40′18″E; 6 October 1987; W. Meijer SAN 122422 (SAN) • Ranau, Bundu Tuhan, Kinatongan; 05°57′57″N, 116°32′46″E; 16 July 1993; Doinis Soibeh DS 293 (SAN, SNP) • Ranau, Kinabalu; 06°05′30″N, 116°32′45″E; 1100 m elev.; 12 March 1970; H. P. Nooteboom 1583 (L) • same locality; 914.4 m (3000 ft) elev.; 18 September 1931; Clemens & Clemens 26733 (L) • same locality; 1219 m elev.; 1931; Clemens & Clemens 51420 (L) • Ranau, Lohan Ulu; 05°46′04″N, 116°49′08″E; 9 November 1987; Amin & Jarius SAN 121417 (SAN) • Ranau, Sungai Bundu Tuhan, primary forest; 05°58′15″N, 116°31′47″E; 3 September 1971; Aban G. SAN 74128 (SAN) • Ranau, Sungai Mangkadau; 05°56′54″N, 116°40′01″E; 457.2 m (1500 ft.) elev.; 29 May 1973; G. Shea & Aban SAN 77263 (SAN) • Ranau, Tenompok Forest Reserve, secondary forest; 05°57′40″N 116°32′18″E; 9 m elev.; 8 September 2016; Suzana et al. SAN 157738 (KEP, SAN) • Ranau, Tenompok, Mount Kinabalu; 06°05′30″N, 116°32′45″E; 1524 m elev.; 22 April 1932; Clemens & Clemens 29144 (L) • Ranau, Tenompok; 05°58′58″N, 116°30′40″E, 1524 elev.; 1931; Clemens, J. & Clemens, M. S., Clemens & Clemens (L) • Ranau, Tontolob, hillside; 05°44′05″N, 116°23′32″E; 18 October 1988; Amin et al., SAN 129318 (SAN) • Ranau, Ulu Sungai Nabutan; 05°52′21″N, 116°49′13″E; 20 August 1983; Amin & Dewol SAN 100207 (SAN) • Ranau, West of Kg Takutan; 06°05′25″N, 116°46′42″E; 609.6 m (2000 ft.) elev.; 24 May 1973; G. Shea & Aban SAN 77165 (SAN) – **Sandakan** • Kinabatangan, Sukau, WWFM small plots; 05°31′47″N, 118°18′09″E; Georgina B. & Reza Azmi GB 210 (SAR) • Sandakan, Bukit Garam, disturbed forest; 05°30′28″N, 118°13′15″E; 27 February 1987; George et al., SAN 117665 (SAN) • Sandakan, Jalan Pengakalan Sepilok Forest Reserve; 05°49′36″N, 117°57′04″E; 16 June 1970; P. P. Sam & Dewol SAN 7029 (SAN) • Sandakan, Kabili-Sepilok Forest Reserve; 05°48′36″N, 117°59′21″E; 6 m elev.; 27 May 1937; Keith, H. G., Keith 7160 (L) • Sandakan, Labuk Sugut, Sungai Sasau; 06°02′05″N, 117°12′13″E; 21 September 1984; Sigin & Amin SAN 67562 (SAN) • Sandakan, Lamag, Ulu Sungai Lokan, logged over area slope; 05°29′51″N, 117°20′03″E; 10 November 1979; Aban & Petrus SAN 90685 (SAN) • Sandakan, Myburgh Prov.; 05°52′06″N, 117°55′59″E; 1921; Elmer A. D. E., Elmer 20210 (L) • Sandakan, Sepilok Forest Reserve, 05°49′36″N, 117°57′04″E; 6.096 m (20 ft.) elev.; 15 August 1970; Patrick L. SAN 66666 (SAN) • same locality; 15.24 m (50 ft.) elev.; 6 June 1969; P. F. Cockburn, SAN 65619 (SAN) • Sandakan, Sukau, Keruak Forest Reserve, on rock faces at the base of the hill; 05°31′45″N, 118°17′15″E; 16 September 1996; R. Kiew & Lim S. P., RK 4185 (SAN) • Telupid, Tangkulap, lowland mixed dipterocarp forest; 04°58′41″N, 116°52′11″E; 103.63 m (340 ft.) elev.; 21 October 2004; John B.S. SAN 119247 (SAN) • Tongod, Pinangah; 5°15′12.3″N, 116°50′28.7″E; 180 m elev.; 17 July 1981; Dewol S. SAN 93770 (SAN) – **Tawau** • Lahad Datu, Ganduman Forest Reserve, South-East of Kampung Tegupi on flat land; 05°23′31″N, 119°05′11″E; 21.336 m (70 ft.) elev.; 15 September 1975; Saikeh SAN 82352 (SAN) • Lahad Datu, Tabin Wildlife Sanctuary; 05°12′N, 118°30′E; 25 February 2009; J. T. Pereira et al. JTP 682 (SAN) • Lahad Datu, Ulu Sungai Segama; 04°57′24″N, 117°37′03″E; 200 m elev.; 2 March 1985; Argent et al. SAN 107675 (SAN) • Tawau, Luasong, SF logging area; 04°36′23″N, 117°24′03″E; 8 August 1977; Fidilis K. SAN 87303 (SAN) • Tawau, Tanjong Forest Reserve; 04°49′00″N, 117°55′00″E; 1 April 1964; W. Meijer SAN 42993 (SAN).

Identification. An unmistakable aroid liane by virtue of the mature leaves with prominently reticulate venation, perforations and pinnation. Ripe fruits with domed stylar tissue resembling white berries (Nguyen and Boyce 1999).

Distribution and ecology. Widespread in Sabah. Low to middle elevation humid to wet primary lowland rainforest to disturbed evergreen forest on a variety of substrates; 65–1500 m elev.

Anadendrum Schott

All the herbarium specimens belonging to *Anadendrum* are identified as undescribed species. The number of species is estimated to be approximately 10 based on 43 collections seen.

Anadendrum sp. 1

Material examined. MALAYSIA – **Pedalaman** • Tenom, Kg. Kapulu, side path, primary forest; 04°50′41″N, 116°01′58″E; S. Lantoh, SAN 73533 (SAN) – **Pantai Barat** • Ranau, Poring, secondary forest; 06°02′44″N, 116°42′02″E; 24 December 1990; W. Meijer & Abu Bakar, SAN 131913 (SAN) – **Kudat** • Ulu Sungai Kaindangan, along coupe boundary clear undergrowth; 06°31′ 33″N, 117°15′16″E; 16 October 1975; Saikeh & Aban, SAN 82373 (SAN) – **Tawau** • Tawau, Mt. Wullersdorf Forest Reserve, around Teck Guan Quary, limestone; 04°27′29″N, 118°08′49″E; Nadiah I., Postar M., Jemson J., & Ubaldus M., SAN 149146 (K, KEP, SAN, SAR).

Anadendrum sp. 2

Material examined. MALAYSIA – **Pantai Barat** • Ranau, between Kg. Nabutan and Kg. Sagindai; 05°52′ 21″N, 116°49′13″E; 20 July 1979; Aban G., SAN 91015 (SAN) • Ranau, Kg. Randagong area, side of stream; 05°52′37″N, 116°35′03″E; 11 May 1984; Amin et al., SAN 56046 (SAN) • Ranau, about 2 miles NW of Kg. Pinawantai; 06°10′57″N, 116°45′35″E; 12 May 1973; G. Sheah & Aban, SAN 76956 (SAN) • Ranau, Bukit Kulung; 06°01′26″N, 116°40′18″E; 1 October 1987; W. Meijer,

SAN 122478 (SAN) • location unknown; 24 October 1931; Clemens J., with Clemens M.S., Clemens & Clemens 26741 (L) • location unknown; 27 August 1931; Clemens, J., Clemens, M.S., Clemens & Clemens 26217 (L) • location unknown; 11 March 1933; Clemens, J., with Clemens, M.S., Clemens & Clemens 32179 (L).

Anadendrum sp. 3

Material examined. MALAYSIA – **Pedalaman** • Keningau, Highland Plantation, mile 11; 05°12′21″N, 116°11′37″E; 8 June 1977; Talip A.H., SAN 85437 (SAN) • Keningau, Ulu Senagang; 05°21′54″N, 116°01′25″E; 19 May 2010; Sugau J. B., SAN 151920 (K, SAN).

Anadendrum sp. 4

Material examined. MALAYSIA – **Pantai Barat** • Nabawan, Sungai Milian, hilltop; 04°59′56″N, 116°29′59″E; 6 November 1986; Asik Mantor, SAN 118559 (SAN).

Anadendrum sp. 5

Material examined. MALAYSIA – **Pantai Barat** • Sapulut, Batu Punggul, hillside; 04°37′48″N, 116°36′57″E; 28 January 1993; Kuntil Loloh, SAN 135788 (SAN) • Pensiangan, Pensiangan Utara sub-district, Kg. Batu, Bukit Pun Batu; 04°47′30″N, 116°11′33″E; 24 October 1996; Lim S.P. et al., LSP 1509 (SAN) • Pensiangan, Pensiangan Utara sub-district, Kg. Batu, Bukit Pun Batu; Lim S.P. et al., LSP 1556 (SAN) • Sapulut, Batu Punggul, hillside; 04°37′48″N, 116°36′57″E; 30 January 1993; Sumbing J., SAN 136100 (SAN) • Sapulut, Sungai Siliawan, upland mixed dipterocarp forest, near the forest edge, along the small stream; 04°43′05″N, 116°31′28″E; 13 June 2012; Suzana S., Nur Adillah M.Y., Noor Azmizah A., Markus G., Ubaldus M., & Aloysius L., SAN 154837 (SAN).

Anadendrum sp. 6

Material examined. MALAYSIA – **Sandakan** • Telupid, Sungai Ruku-ruku, primary forest on flat land; 05°36′10″N, 117°09′53″E; 4 August 1981; Aban G., SAN 94003 (SAN) • Sandakan, Maliau Basin Conservation Area, Pakis Camp, Upper dipterorcarp; 04°30′00″N, 116°45′00″E; 15 March 2001; Henry B. & Sidkan A., MB 784 (SAN) – **Tawau** • Tawau, Kunak, Madai-Baturong Forest Reserve, Sungai Siput Madai; 04°41′18″N, 118°1′55″E; 8 July 2000; Diwol S. & Ruth Kiew et al., SAN 133143 (K, SAN, SING) • Tawau, Kalabakan, Gunung Rara, ca. 50 m from base camp area; 04°59′28″N, 117°08′03″E; 13 March 2015; Suzana S., Nur Adillah M.Y., Baraham B. & David J., SAN 157097 (SAN) • location unknown; 18 March 1970; Nooteboom, H.P., H.P.Nooteboom 1623 (L) • location unknown; 15 November 1968; Ogata K., K.Ogata 11473 (L).

Anadendrum sp. 7

Material examined. MALAYSIA – **Sandakan** • Beluran, Bukit Mesasah near campsite, primary forest, ultrabasic soil; 05°58′12″N, 117°15′10″E; 17 May 1961; W. Meijer, SAN 25433 (SAN) • Beluran, Sugut Forest Reserve, along trail to Gua Sam Manan, lowland mixed dipterocarp kerangas forest; 06°18′67″N, 117°37′21″E; 26 September 2014; Ubaldus M., Tawadong T., & Baraham, B. SAN 157487 (SAN) • Beluran, Telupid Road to microwave, ultrabasic soil, lowland dipterocarp forest; 05°36′30″N, 117°50′00″E; 30 June 2007; Pius G., Joel, D., Maidil A., & Aloysius L., SAN 149062 (K, SAN) • Beluran, Trusan Sugut Forest Reserve, near Gua Sam Manan, below the rock cliff; 06°25′16″N, 117°41′58″E; 15 November 2017;Sugau J.B., Markus G. & Adzwan S., SAN 158928 (SAN) • Telupid, Bukit Tangkunan, T.V. Station Road, 05°38′33″N, 117°11′36″E; 30 January 1982; Abd. Rahim et al., SAN 92955 (SAN).

Anadendrum sp. 8

Material examined. MALAYSIA – **Sandakan** • Kinabatangan, Maliau Basin Conservation Area, Camel Trophy Camp, mountainous; 04°49′46″N, 116°53′49″E; 10 April 2000; Edward A. & Sidkan A., MB 109 (SAN) • Kinabatangan, mile 17 ½ Karis-Karis camp, primary forest, on hillside; 05°16′55″N, 117°27′52″E; 11 May 1970; Patrick Lassan, SAN 70652 (SAN) • Sandakan, Danum Valley Conservation Area, Danum Valley Field Centre, path from Segama bridge to water pool, lowland dipterocarp rainforest; 05°01′00″N, 117°48′00″E; J. Gregson & Bernadus Bala Ola, JG 65 (K, SAN) • Sandakan, Sepilok Forest Reserve, mixed dipterocarp forest; 23 April 1996; A. Hay et al., A.Hay 12157 (SAN) • Telupid-Ranau Road, Mile 8 Telupid Ranau Road, on flat land, primary forest; 05°39′24″N, 117°04′15″E; 12 March 1974; Aban G. & Saikeh, SAN 79370 (SAN) • Sandakan, Sepilok Forest Reserve, mixed dipterocarp forest; 05°49′36″N, 117°57′04″E; 17 January 1989; Kessler, SAN 118162 (SAN) • Telupid, base of Bukit Tawai, logged over area; 05°31′51″N, 117°06′17″E; 8 April 1994; Leopold M., SAN 134275 (SAN) • location unknown; November 1986; Vermeulen J.J., Lam, A.L., J.J.Vermeulen 760 (L).

Anadendrum sp. 9

Material examined. MALAYSIA – **Tawau** • Lahad Datu, Ulu Sungai Danum just North of Camp 111; 04°56′00″N, 117°29′45″E; 3 September 1976; *B.C. Stone et al., SAN 85304* (SAN).

Anadendrum sp. 10

Material examined. MALAYSIA – **Sandakan** • Kinabatangan, Gomantong Caves, lowland rainforest on limestone boulder; 05°31′52″N, 118°04′17″E; 24 April 1996; A. Hay et al., A.Hay 12163 (SAN) • Kinabatangan, Gomantong; 05°31′52″N, 118°04′17″E; 21 June 1992; W. Meijer, SAN 136166 (SAN).

Bucephalandra danumensis S.Y.Wong, P.C.Boyce & Kartini

Figure 3G

Material examined. MALAYSIA – **Tawau** • Lahad Datu, Danum Valley near second waterfall; 04°57′30″N,

117°41′47″E; 21 January 1991; A. Bahaman et al. SAN 134426 (SAN) • Lahad Datu, Danum Valley Conservation Area, Kawag, Ali Baba Trail, Ali Baba Falls; 05°02′42″N, 117°58′ 51″E; 119 m elev.; 8 July 2018; Wong Sin Yeng, P. C. Boyce & Kartini Saibeh (SAR).

Identification. *Bucephalandra danumensis* is differentiated from all other *Bucephalandra* species with echinate/papillate spadix appendix staminodes by the combination of the appendix and staminate flower zone being of about equal length, by the ellipsoid thecae separated by a deep sinus on the ventral surface, needle-like thecae extensions that curve upwards and interstice staminodes with conspicuously thickened, recurved margins. In appearance plants of *B. danumensis* most closely resemble those of *B. yengiae* P.C.Boyce from Kalimantan Timur, and an imperfectly known undescribed species from Kalimantan Utara; *B. danumensis* differs from both by the equal proportions of the appendix and staminate flower zones (vs. appendix appreciably longer than staminate flower zone), and by the thick recurved margins of the interstice staminodes (vs. staminode margins not or scarcely thickened, and not recurved). *Bucephalandra danumensis* differs from the only other *Bucephalandra* species from Sabah, *B. ultramafica* S.Y.Wong & P.C.Boyce, by the echinate/papillate appendix staminodes (vs. polygonal with very rounded angles, somewhat umbonate) and by not being obligated to ultramafic (ultrabasic) rocks (Wong et al. 2018).

Distribution and ecology. Endemic to Sabah. Known only from two localities, approximately 20 km distant, in the Danum Valley Conservation Area. Restricted to igneous stream beds and waterfalls outcropping through Cretaceous deepwater sediments in lowland perhumid forest between elevations of 120 and 310 m.

Bucephalandra ultramafica S.Y.Wong & P.C.Boyce

Figure 3H

Material examined. MALAYSIA – **Sandakan** • Kinabatangan, Telupit, Gunung Tawai; 05°35′46″N, 117°04′ 37″E; 18 Dec 2012; M. Lo AR-4094 (holo SAN, iso SAR, SBC, SING).

Identification. *Bucephalandra ultramafica* is unique by the combination of deeply ridged petioles, narrow deep green glossy leaves, and a bullet-shaped appendix. The leaf blades are somewhat reminiscent of those of *B. goliath* S.Y.Wong & P.C.Boyce, but *B. ultramafica* never develops the long pendent stems diagnostic of *B. goliath*, and the spadix appendix and appendix staminodes are of quite different form (Wong and Boyce 2014).

Distribution and ecology. Endemic to Sabah. Known only from the type locality at Gunung Tawai. Restricted to ultramafic (ultrabasic) riverside rocks under lowland moist forest at ca. 130 m elev.

Colocasia oresbia A.Hay

Figure 4A

Material examined. MALAYSIA – **Pedalaman** • Sipitang, Sungai Melabid at lower Eastern slope of Ruan Watgerauo; 04°23′51″N, 115°40′57″E; 1300 m elev.; 17 April 2000; Pius G. et al. SAN 143466 (SAN) • Tambunan, Gunung Alab; 05°49′53″N, 116°20′24″E; 1600 m elev.; 12 December 1968; Kokawa & Hotta 1934 (L) • Tambunan, Alab, along the road from Agr. Exp. Station to south of Gunung Alab; 05°50′05″N, 116°21′04″E; 1500 m elev.; 11 December 1968; Kokawa & Hotta 1758 (L) – **Pantai Barat** • Ranau, Mount Kinabalu National Park, along road to summit; 06°4′N, 116°27′E; 2000-3000 m elev.; 27 September 1981; T. B. Croat 53134 (MO, SAR).

Identification. *Colocasia oresbia* is readily distinguished from wild-type *C. esculenta* by its non-waxy, wettable leaf blades, rather long stout stem thickly clothed in old leaf bases, lack of stolons, preference for non-saturated sites, much more robust infructescence, straight fruiting peduncle and its brown-tinged green (vs. yellow-orange) fruits (Hay 1996).

Distribution and ecology. Endemic to Sabah. Western and Southwestern Sabah. Disturbed, mostly rather open sites on banks and road cuttings at ca. 1500 m elev.

Cryptocoryne ciliata (Roxb.) Fisch. ex Wydler

Material examined. MALAYSIA – **Tawau** • Kalabakan, 04°40′N, 117°51′E; 28 July 2008; Ubaldus, Jemson & Postar SAN 149636 (SAN) • Lahad Datu, Sungai Gadun; 05°22′95″N, 118°49′03″E; 17 February 2009; Joel et al. SAN 149691 (KEP, SAN).

Identification. The ciliate margin of the spathe limb is diagnostic for this species (Jacobsen 1985).

Distribution and ecology. This is a first record for the genus *Cryptocoryne* for Sabah. Mudflats in small or large rivers, ditches, and canals, in tidal areas, in brackish water. The plants often grow in open sun and are mostly covered with a distinct layer of silt.

Epipremnum falcifolium Engl.

Material examined. MALAYSIA – **Pedalaman** • Keningau, Sook, Sook Plain; 05°07′37″N, 116°16′28″E; 19 October 1987; W. Meijer & Kumin SAN 121389 (SAN) – **Sandakan** • Labuk & Sugut, along Sungai Meliau, foot of Mt. Tawai; 05°30′33″N, 117°03′51″E; 100 m elev.; 22 October 1968; Kokawa & Hotta 263 (L) – **Tawau** • Lahad Datu, Danum Valley; 04°56′35″N 117°36′25″E; 9 June 1990; Mariyoh & Lideh SAN 111746 (SAN).

Identification. *Epipremnum falcifolium* is found in Brunei, Malaysia (Sabah) and Indonesia (Kalimantan). *Epipremnum falcifolium* has similar infructescences with massively enlarged stylar tissue but they can usually be readily separated on leaf characters. Dried inflorescences and infructescences of *E. falcifolium* have the region around stigma expanded into two lateral cushions. *Epipremnum falcifolium* often produces fruits with a solitary seed by abortion (Boyce 1998).

Distribution and ecology. Widespread. Near rivers, mixed dipterocarp forest, swampy secondary forest, Setap shales, clay soil, yellow sandy loam; 5–250 m elev.

Figure 4. *Colocasia* and *Homalomena* in Sabah. **A.** *Colocasia oresbia*. **B.** *Homalomena galbana*. **C.** *Homalomena gillii*. **D.** *Homalomena kionsomensis*. **E.** *Homalomena portae-inferni*. **F.** *Homalomena marasmiella*.

***Epipremnum pinnatum* (L.) Engl.**

Material examined. MALAYSIA – **Kudat** • Pulau Balambangan, Southern peninsula end, northern face; 04° 56′35″N, 117°36′25″E; 10 April 1977; collector unknown, SAN 85522 (SAN) – **Tawau** • Sipadan Island, forest trail along trail from northwest of the island to the southern tip of the island; 04°06′55″N, 118°37′43″E; 14 October 1993; K.M. Wong, Berhaman & Suin K. M. Wong 2539 (SAN).

Identification. *Epipremnum pinnatum* can be distinguished from the superficially similar *Raphidophora korthalsii* by its primary lateral vein, stem, feeding root, pre-adult stage, the fertile stage (the style apex and the shape of the stigma) and its fruits (Boyce 1998).

Distribution and ecology. Widespread. Primary and secondary dense to open lowland to upper hill rain and monsoonal forest, weeds of rubber plantation, growing occasionally on rocks and in coastal forest, on a variety of substrate including granite, andesite and limestone; 1–1600 m elev.

***Gamogyne burbidgei* N.E.Br.**

Material examined. MALAYSIA – **Pedalaman** • Nabawan, Sungai Maadun, Syt. Benawood, Sungai Maadun; 04°51′31.1″N, 116°34′48″E; 27 May 1987; Fidilis krispinus SAN 119394 (SAN) • Pensiangan, Batu Tinahas; 04°36′29″N, 116°35′11″E; 16 May 1997; R. Kiew 4404 (SAN) • Sipitang, Sungai Pasia; 04°25′11″N, 115° 42′14″E; 1000 m elev.; 27 June 1997; A. Lamb MTED 404 (SAN) • Tenom, Lumaku Forest Reserve, 05°07′37″N, 115°56′29″E; 929 m elev.; 19 March 2010, Suzana, S., Ubaldus, M., Tawadong, T., Markus, G., John, B., SAN 150993 (SAN, K) – **Sandakan** • Tongod, Gunung Tingkar Forest Reserve, 05°18′28″N, 117°04′23″E; 121 m elev.; 4 April 2013; Suzana S., SAN 150245 (SAN).

Identification. *Gamogyne burbidgei* is defined by connate pistils, a pistillate flower zone with a conspicuous zone of pistillodes at base, a spadix fertile to the tip, thecae not set in deep pits, parietal placentation, the spathe remaining tubular with an oblique terminal orifice during most of pistillate anthesis, and only inflating at staminate anthesis, by the spathe limb rostrum not reflexing at staminate anthesis and lacking rostral keels, and by roots producing with copious plantlets (Low et al. 2018).

Distribution and ecology. Common in Western Sabah, extending down to the Crocker Range until Brunei. Rheophytic among boulders in stream beds or on stream banks, below 100 m elev.

***Homalomena galbana* Baharuddin & P.C.Boyce**
Figure 4B

Material examined. MALAYSIA – **Sandakan** • Maliau Basin Conservation Area, environs of Camp Ginseng, 2005, Baharuddin 11076 (holo, Universiti Sains Malaysia).

Identification. *Homalomena galbana* is immediately distinguishable from all other described Bornean species by the combination of its mesophytic habit and comparatively large spathe lacking a constriction between the lower spathe and limb. The only described species in Borneo with a similar spathe is *H. expedita*, but this is a colonial helophyte, has markedly different spadix morphology, and has yet to be recorded from Sabah. Among mesophytic species some larger expressions of *H. griffithii* (Schott) Hook.f. [Chamaecladon Supergroup] are vaguely similar in appearance to *H. galbana* but differ by the smaller spathes (less than 2 cm long), the interpistillar staminodes much shorter than the associated pistils, and smaller infructescences. The spathe becoming yellow at anthesis is highly distinctive and represents a novel morphology for *Homalomena*; furthermore, yellow is a rare spathe colour among terrestrial mesophytic aroids in general (Baharuddin and Boyce 2010).

Distribution and ecology. Endemic to Sabah. Known only from the type collection. Perhumid evergreen upper hill forest on mudstone, along small streams, ca. 700 m elev.

***Homalomena gempal* Kartini, P.C.Boyce. & S.Y.Wong**

Material examined. MALAYSIA – **Tawau** • from plant cultivated at Institute for Tropical Biology and Conservation, Kota Kinabalu; 4 Jan 2015; Kartini BORH 2702 (original living collection: Malaysian Borneo, Sabah, Tawau, Tawau Hills N.P., Bukit Galas, Dec 2014, Kartini) (holo, BORH).

Identification. *Homalomena gempal* differs from Sarawak *H. atrox* P. C. Boyce et al. and *H. paucinervia* Ridl by its squat pistils, its subglobose sessile interpistillar staminodes and its longitudinally finely ridged petioles, peduncle, and spathe limb exterior (Kartini et al. 2015a). Refer to *H. kionsomensis* for comparison (below).

Distribution and ecology. Endemic to Sabah. Known only from a restricted area at the type locality, Tawau Hills N.P., Bukit Galas. *Homalomena gempal* occurs as a strongly rooted rheophyte on exposed rhyolite under very wet lowland to lower hill forest at the base of waterfalls at an elevation of ca. 380 m elev.

***Homalomena gillii* Furtado**
Figure 4C

Material examined. MALAYSIA – **Pantai Barat** • Penampang, Crocker Range Forest Reserve, Kg Kibunut; 05°56′12″N, 116°14′08″E; 16 May 2011; Leong et al. PL 490 (SAN, SING).

Identification. Erect to creeping herb. Petiole length variable, shorter or longer than the leaf blade, 5–15 cm long, sheathing up to halfway. Leaf blade usually leathery, oblong, ovate to obovate-lanceolate, to elliptic, sometimes somewhat falcate, the base acute to obtuse, blades 9–20 cm long, 2.5–6 cm wide, primary lateral veins 6–9 per side, alternating with an equal number of slender interprimaries. Peduncle 4–8 cm long, slender, shorter than the petiole, rarely sub-equaling petiole.

Spathe ovate, the tip abruptly and strongly attenuate-cuspidate, lower spathe 1–1.5 cm long, 8–12 mm wide, spathe limb ca. 3 cm long, 3–5 mm wide. Spadix subequaling the spathe, subsessile pistillate zone 8–12 mm long, about three times long than wide, 3 cm long, the top 3–4 mm wide. Furtado (1939).

Distribution and ecology. Endemic to Sabah. Found growing on granite at low elevations.

Homalomena kinabaluensis Furtado

Material examined. MALAYSIA – **Kudat** • Pitas, Paitan, Hutan Simpan Paitan; 06°42′30″N, 117°9′30″E; 14 May 1987; George & Amin K., SAN 121273 (SAN) – **Sandakan** • Tongod, Imbak; 05°10′29″N, 117°09′13″E; 213.36 m elev.; 14 June 2000; SAN 142898 (SAN).

Identification. *Homalomena kinabaluensis* is a high-altitude ultrabasic-associated species and is unusual in the genus by having the spathe and peduncle deep purple and is one of rather few ultrabasic-obligated aroids described to date (Kartini et al. 2015a).

Distribution and ecology. Endemic to Sabah. High-elevation, ultrabasic-obligated.

Homalomena kionsomensis Kartini, P.C.Boyce & S.Y.Wong

Figure 4D

Material examined. MALAYSIA – **Pantai Barat** • Cultivated in Faculty of Sustainable Agriculture, Universiti Malaysia Sabah, Sandakan, Sabah. Original collection: Malaysia, Sabah, West Coast Division, Kota Kinabalu, Inanam, Kionsom Waterfall; 05°58′26″N, 116°12′30″E; 270 m elev.; 23 June 2018; Kartini BORH 2706 (holo BORH).

Identification. *Homalomena kionsomensis* is most similar to *H. gempal* differing by the shortly stipitate spadix which extends at anthesis to exceed the spathe (vs. spadix sessile, not extending and remaining within the length of the spathe throughout anthesis), the weakly clavate (vs. sessile subglobose) interpistillar staminodes, and smooth (vs. longitudinally finely ridged) petioles, peduncle, and spathe limb exterior (Kartini et al. 2019).

Distribution and ecology. Endemic to Sabah. Only known from the type locality where it is moderately abundant, Kionsom Waterfall, Inanam, Kota Kinabalu. Moist lowland forest on Oligocene deepwater sandstones, mostly occurring on the lower parts of shady consolidated alluvium soil banks at about 200 m elev.

Homalomena marasmiella Kartini, P.C.Boyce. & S.Y.Wong

Figure 4F

Material examined. MALAYSIA – **Sandakan** • Labuk & Sugut/Kinabatangan border, Telupid, Sungai Telupid; 05°35′49″N, 117°04′35″E; 128 m elev.; 25 Mar 2015; M. Lo AR5192 (holo SAN, iso SAR).

Identification. *Homalomena marasmiella* differs from Sarawak *H. stella* P.C.Boyce & S.Y.Wong and *H. vagans* P.C.Boyce, the two species it most closely resembles, by the mushroom-shaped interpistillar staminodes and cut tissues smelling of coriander leaves (vs. columnar interpistillar staminodes and tissues with a smell reminiscent of turpentine). *Homalomena marasmiella* is further distinguished from *H. stella* and *H. vagans* by being restricted to ultramafic rocks (*H. stella* and *H. vagans* occur almost exclusively on shale). From *H. stella*, *H. marasmiella* is differentiated by having the leaves scattered along a creeping and rooting rhizome-like stem (vs. a rosette of leaves on a compact, erect stem) and the presence of a naked interstice separating the pistillate and staminate flower zones. From *H. vagans*, *H. marasmiella* is differentiated additionally by chartaceous leaf blades. All observed plants of *H. marasmiella* have the leaf blades with fine broken streaks of pale grey variegation approximately coinciding with the primary lateral veins, whereas *H. stella* and *H. vagans* have plain green leaves (Kartini et al. 2015a).

Distribution and ecology. Endemic to Sabah. *Homalomena marasmiella* is known only from the type locality, Sungai Telupid, Labuk & Sugut, Telupid. *Homalomena marasmiella* occurs on lightly shaded vertical earth banks over ultramafic rock under moderately humid lowland forest at an elevation of ca. 130 m.

Homalomena portae-inferni S.Y.Wong, J.Joling & P.C.Boyce

Figure 4E

Material examined. MALAYSIA – **Tawau** • Tawau Hills Park, trail to Hot Springs; 28 Nov 1998; J. T. Periera, L. Madani, V. L. Pung, Ubaldus M., Salamat A. J.T.P. 572 (holo SAR, iso K, KEP, L)

Identification. *Homalomena portae-inferni* is most similar to *H. kionsomensis*, differing by pistillate florets in two rows (vs. three to four rows), pistils without glands (vs. pistils with minute red glands), with the associated staminode oblong and pale green (vs. staminode almost globose on a very short hair-like stipe, and pale yellow), stigma ca. 1 mm in diam. (vs. 0.5 mm), and staminate florets pale green (vs. cream) (Wong et al. 2020a).

Distribution and ecology. Endemic to Sabah. Known only from the type locality at Tawau Hills Park, trail to Hot Springs. Forms large patches or occurs as smaller plants on moss-covered peat domes under *Shorea argentifolia* and *Tristaniopsis*-dominated lowland kerangas on Pleistocene volcanics, with elevation between 200 and 320 m elev.

Homalomena rostrata Griff.

Material examined. MALAYSIA – **Pedalaman** • Keningau, Crocker Range Forest Reserve, Mile 16 highland plantation Crocker Forest Reserve; 05°51′15″N, 116°18′50″E; 1219.2 m elev.; 12 June 1977; A. H. Talip & Ejan SAN 87012 (SAN) • Sipitang, Mengalong Forest Research; 05°00′30″N, 115°29′11″E; 22 May 1990; W. Meijer SAN 130248 (AA, SAN) • same locality; 22

May 1990; W. Meijer SAN 130248 (AA, SAN) • Tambunan, Sungai Kiluyu Forest Reserve; 05°36′36″N, 116°20′84″E; 500 m elev.; 11 February 2015; Nur Adillah et al. SAN 157540 (SAN) – **Pantai Barat** • Ranau, along Japanese trail, Wonod River; 05°39′35″N, 117°03′08″E; 11 September 1971; Leopold, Gary & Dewol SAN 74311 (SAN) – **Sandakan** • Gomantong, Tinangul; 05°31′51″N, 118°04′45″E; 304.8 m elev.; 20 March 1964; J. Ampuria SAN 41519 (K, SAN, SAR) • Sandakan, 2 miles NW of Kampong Gambaran; 05°37′09″N, 117°08′49″E; 91.44 m elev.; 10 May 1965; W. Meijer SAN 51543 (SAN).

Identification. Colonial helophytes with strongly aromatic vegetative tissues. Leaf blades very variable, ranging from linear-lanceolate to broadly sagittate. Spathe with a marked constriction between the lower part and the limb; entire limb persistent into ripe fruit; mature fruits small, yellow-green.

Distribution and ecology. Widespread. Helophytes in fresh swamp and shaded forest.

Homalomena cf. *sarawakensis* Ridl.

Material examined. MALAYSIA – **Kudat** • Kota Marudu, Marak-Parak; 06°18′50″N, 116°44′13″E; 4 April 1987, Amin & Pius SAN 119003 (SAN) • Pitas, Paitan, Hutan Simpan Paitan; 06°42′29″N, 117°09′30″E; 15 May 1987; George & Amin SAN 121274 (SAN) – **Pantai Barat** • Ranau, Ulu Tungud Forest reserve, Gunung Monkobo expedition; 05°52′52″N, 116°58′12″E; 27 July 2005; Saw et al. 146060 (A, K, L, KEP, SAN, SAR) – **Sandakan** • Beluran, Labuk Bukit Mangkanana; 05°45′50″N, 117°01′08″E; 100 m elev.; 14 August 1982; Dewol Sundaling SAN 90440 (SAN) • Kinabatangan, Penangah Forest Reserve, side of stream; 05°01′45″N, 116°43′14″E; 28 April 1987; Joseph B., Patrick & Gambio SAN 119158 (SAN) • Labuk Sugut, Sungai Piso; 05°50′42″N, 117°05′17″E; 300 m elev.; 16 April 1980; Aban Gibot & Dewol S. SAN 91639 (BRUN, SAN) • Pinangah, Ulu Sungai Pinangah; 04°44′45″N, 116°37′00″E; 29 August 1984; Leopold & Dewol SAN 64578 (SAN) – **Tawau** • Tawau River Forest Reserve; 04°22′26″N, 117°35′40″E; 6 July 1959; W. Meijer SAN 19469 (SAN) • locality unknown, 25 October 1968; Kokawa & Hotta 466 (L).

Identification. *Homalomena sarawakensis* is a northwestern Borneo limestone endemic and does not occur in Sabah (Wong et al. 2013). This is an undescribed species.

Distribution and ecology. Widespread.

Homalomena simunii Kartini, P.C.Boyce, & S.Y.Wong

Material examined. MALAYSIA – **Pedalaman** • Pensiangan, Sapulut Forest Reserve Gunung Maliat; 04° 23′00″N, 116°57′00″E; 1437 m elev.; 21 November 2006; Sugau et al. SAN 149526 (SAN) – **Sandakan** • Kinabatangan, Imbak Canyon Conservation Area; 05°01′34″ N, 117°02′09″E; 389 m elev.; 1 December 2010; Suzana, S., Ubaldus, M. et al. SAN 152707 (SAN) – **Tawau** • Kalabakan, Gunung Rara, PSP 1, about 1 km from base camp; 04°58′26″N, 117°08′57″E; 214 m elev.; 11 March 2015; Suzana et al. SAN 156999 (KEP, SAN).

Identification. *Homalomena simunii* differs from all other species in the genus by the semi-horizontal inflorescences, lax pistils, naked interstice between the staminate and pistillate flower zones and by being restricted to basalt (Kartini et al. 2015a).

Distribution and ecology. Endemic to Sabah. *Homalomena simunii* occurs in lowland to lower hill evergreen perhumid forest on basalts at elevations between 200 and 390 m.

Homalomena vagans P.C.Boyce

Material examined. MALAYSIA – **Sandakan** • Beluran, Bidu-Bidu Forest Reserve; 05°45′04″N, 117°18′36″E; 23 March 2009; Suzana S. SAN 150389 (SAN) • Kinabatangan, Maliau Basin, Maliau Basin Field station; 04° 44′09.5″N, 116°58′36.8″E; 17 April 1996; A. Hay 12106 (SAN).

Identification. The lithophytic habit, creeping stem, and narrow leaf blades is distinctive for the species. The infructescence peduncle in *H. vagans* is unusual in the genus in its erect, not drooping habit (Boyce 1994).

Distribution and ecology. Steep banks near river in primary lowland mixed dipterocarp forest on Setap shale formation; 65 m.

Lasia spinosa (L.) Thwaites

Material examined. MALAYSIA – **Pedalaman** • Beaufort, Klias Forest Reserve, forest between Klias Forest Reserve and Upper Sungai Api-Api; 5 m elev.; 7 May 1998; 05°18′N, 115°40′E; S. P. Lim 1811 (SAN) • Tenom, Agr. Station; 05°10′54″N, 115°59′23″E; 2 November 1987; Mansus & Good SAN 122364 (SAN) – **Sandakan** • Beluran, KBD estate Komansi Labuk; 05°30′00″N, 117°00′00″E; 4 May 1965; W. Meijer & Kodoh SAN 49814 (SAN) • Kinabatangan, Pin, Pin Timber Camp, S of Bt. Pin Besar; 05°23′28″N, 117°52′52″E; 25 November 1968; Kokawa & Hotta 1521 (L) • Sandakan, Komansi River swampy river side, Pamol Estate; 05°37′45″N, 117°08′00″E; 6.096 m (20 ft.) elev.; 14 May 1965; W. Meijer SAN 51629 (SAN) • Sandakan, Laila Eat Corner near town Singapora road; 05°50′06″N, 118°05′46″E; 10-40 m elev.; 16 October 1994; W. Meijer SAN 134360 (SAN).

Identification. Stems suffruticose, erect to decumbent with spiny internodes. Leaves usually dissected, or hastate. Spathe caducous or rarely marcescent. Placentation apical with fruit spiny (Hay 1992).

Distribution and ecology. Southwestern and northeastern Sabah. Found growing in swamps, riverbanks, ditches, moist places, occasionally in boggy places in forest undergrowth in tropical and subtropical forests. Sometimes cultivated along fishponds and rice fields.

Nabalu corneri (A.Hay) S.Y.Wong & P.C.Boyce

Figure 5A

Material examined. MALAYSIA – **Pedalaman** • Tenom,

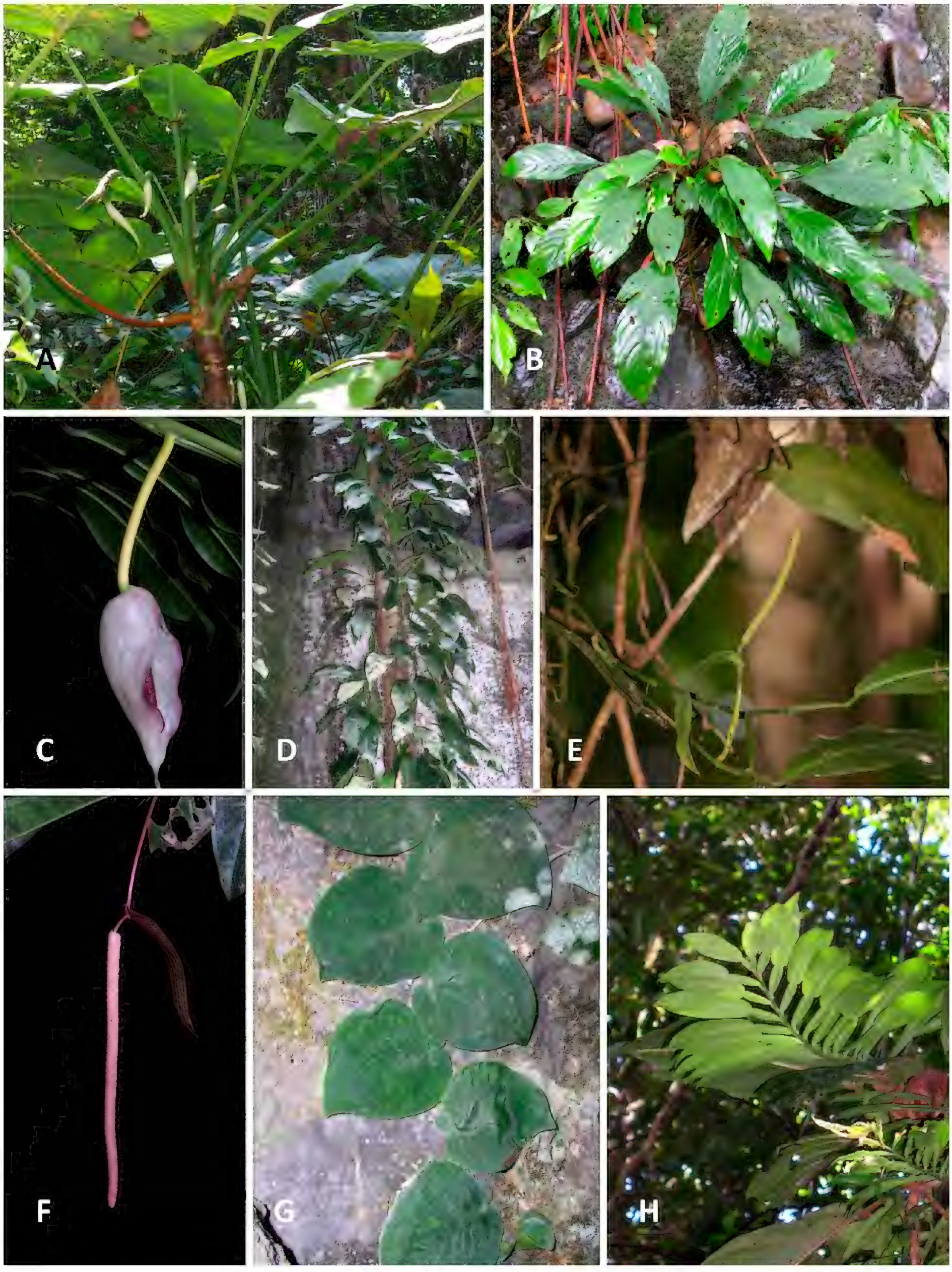

Figure 5. *Nabalu*, *Ooia*, and *Pothos* in Sabah. **A.** *Nabalu corneri*. **B.** *Ooia kinabaluensis*. **C.** *Pothos atropurpurascens* (inflorescence). **D.** *Pothos insignis*. **E.** *Pothos leptostachyus*. **F.** *Pothos mirabilis*. **G.** *Pothos ovatifolius*. **H.** *Pothos scandens*.

Trus Madi, Batu Lapan; 05°38′20″N, 116°27′05″E; 731 m elev.; 26 March 1999; Ruth Kiew 4670 (SAN) – **Pantai Barat** • Ranau, Kinabalu, Silau Basin, Upper Kinabalu; [06°05′30″N, 116°32′45″E], 1829 m elev.; 1829 m elev.; 19 April 1932, Clemens & Clemens 29156 (L) • Ranau, Mount Kinabalu, Dallas, [06°5′30″N, 116°32′45″E], 1000 m elev.; 1931; Clemens & Clemens s.n. (L) • same locality; 1000 m elev.; April 1932; Clemens & Clemens 29157 (L) • Ranau, Mount Kinabalu, Eastern Shoulder; [06°05′N, 116°36′40″E]; 1066.8 m (3500 ft.) elev.; 18 June 1961; E. J. H. Corner & A. Stainton RSNB 642 (SAN) – **Sandakan** • Maliau Basin Conservation Area, Rafflesia Camp; 04°49′46″N, 116°53′49″E; 500 m elev.; 26 April 2000; Ming & Sidkan MB 297 (SAN).

Identification. *Nabalu corneri* is defined by its massive arborescent pachycaul. The leaf sheath wings are persistent. The inflorescence is nodding with the spathe is hardly opening (Low et al. 2018).

Distribution and ecology. Highly localized. Disturbed forest or open sites by rivers among rocks, sometimes in great numbers together, 550–1000 m elev.

Ooia kinabaluensis (Bogner) S.Y.Wong & P.C.Boyce

Figure 5B

Material examined. MALAYSIA – **Pedalaman** • Pensiangan, Pensiangan Utara Sub-District, Kampung Pun Batu, Bukit Pun Batu; 04°47′30″N, 116°11′33″E; 609.6 m (2000 ft.) elev.; 24 October 1996; S. P. Lim et al. LSP 1502 (SAN) • Sipitang, Long Pasia, Sungai Pulau; [04°24′11″N, 115°39′00″E]; 609.6 m (2000 ft.) elev.; 3 September 2002; Postar SAN 145751 (K, SAN) • Sipitang, Long Pasia; [04°24′11″N, 115°39′00″E]; 10 August 1988; Amin et al. SAN 123353 (SAN) • Sipitang, Lower Sungai Maga; [04°24′11″N, 115°39′00″E]; 1200 m elev.; 18 April 2000; S. P. Lim & Soinin SAN 143701 (SAN) • Tambunan, Mount Trus Madi; [05°37′N, 116°30′E]; 1000 m elev.; 19 March 1969; Nooteboom H. P. Nooteboom 1389 (SAN) • Tambunan, Trus Madi, Along Talabao River; [05°33′11″N, 116°31′01″E]; 23 May 1986; Joseph B. et al. SAN 113554 (SAN) • Tambunan, Trus Madi, Mount Trusmadi; [05°25′22″N, 118°14′19″E]; 1000 m elev.; 20 March 1969; Nooteboom H. P. Nooteboom 1417 (L) • Tenom, Katubu; [04°51′47″N, 115°58′03″E]; 533.4 m (1750 ft.) elev.; 29 April 1972; Cockburn SAN 70057 (SAN) – **Pantai Barat** • Kota Belud, Kinabalu Park, Kg Sayap, end of road to Wariu waterfall; 06°19′42″N, 116°22′33″E; 1000 m elev.; 17 January 1998; Jamili Nais SNP 4661 (KEP, SAN)• Kota Belud, Melangkap, Melangkap Kappa, On SW side of Mt. Kinabalu; [06°09′N, 116°31′E]; 600 m elev.; 15 February 1984; Beaman et al. J. H. Beaman, 8594 (L) • Ranau, Kinabalu National Park, along Sungai Dahobang S. side; [06°0′15″N, 116°33′E]; 914.4-1066.8 m (3000-35000 ft.) elev.; 19 September 1965; A. Kanis SAN 51466 (SAN) • Ranau, Kinabalu National Park, area near Park Headquarters, Moss Forest, in wet sandy soil near stream, also among boulders; [06°05′30″N, 116°32′45″E]; July 1986; Vermeulen & Chen J. J. Vermeulen 392 (L) • same locality; 1500 m elev.; 9 October 1968; Ogata K. Ogata 11083 (L) • Ranau, Kinabalu National Park, Eastern Shoulder; [06°05′N, 116°36′40″E]; 1981.2 m (6500 ft.) elev.; 7 July 1961; W. L. Chew, E. J. H. Corner, A. Stainton, RSNB 708 (SAN) • Ranau, Kinabalu National Park, Lungmanis Trail; 06°10′N, 116°34′E; 1000 m elev.; 25 June 2000; A. D. Poulsen ADP 1622 (SAN) • Ranau, Kinabalu National Park, Marai Parai; [06°05′30″N, 116°32′45″E]; 1700 m elev.; 23 March 1933; Clemens & Clemens 32290 (L) • Ranau, Kinabalu National Park, Penibukan, Dahobang river; [06°05′30″N, 116°32′45″E]; 1219.2-1524 (4000-5000 ft.) elev.; 3 March 1933; Clemens, J. & Clemens, M. S., Clemens & Clemens 31876 (A) • Ranau, Kinabalu National Park, Ulu Liwagu, Ulu Mesilou; [06°N, 116°35′E]; 1158.24 m (3800 ft.) elev.; 28 August 1961; W. L. Chew & E. J. H. RSNB 2501 (SAN) • Ranau, Kinabalu National Park, Upper Kinabalu, Upper Kinabalu, Silau Basin; [06°05′30″N, 116°32′45″E]; 2300 m elev.; April 1931; Clemens & Clemens 29135 (L) • Ranau, Kinabalu, Penibukan (Bahandaoi), Sungai Tahubang; [06°00′15″N, 116°33′E]; 900 m elev.; 10 March 1970; Nooteboom & Aban, H. P. Nooteboom 1508 (SAN) • Ranau, Kinabalu, southern slope of Mt. Kinabalu, eastern route, on the riverbanks of the eastern attributary of the Sungai (River) Mesilau Cave and the larger landslide, at old trail between Mesilau Cave and Janet's Halt; [06°05′30″N, 116°32′45″E]; 7 September 1963, Fuchs H. P. & Collenette S. H. Collenette 21634 (K, L) • Ranau, Kundasang near golf course, Montane Forest on valley; 06°01′51″N, 116°35′56″E; 14 March 1986; L. Madani SAN 111616 (SAN) • Ranau, Mesilau River, above upper edge of Mt. Kinabalu golf course site near East Mesilau River, Oak–Laurel Forest, Trusmadi Formation; 06°05′30″N, 116°32′45″E; 13 November 1983; Beaman et al. J. H. Beaman 7473 (L) • Ranau, Mesilou, Hillsides; 05°59′08″N, 116°36′28″E; 1750 m elev.; 3 September 1988; Amin et al. SAN 123519 (SAN) • Ranau, Mesilou, Nature Resort, Nepenthes Trail, Montane forest; 05°59′08″N, 116°36′28″E; 1940 m elev.; 6 July 2010; Pereira J. T. SAN 152369 (SAN) • Ranau, Poring National Park; 06°02′44″N, 116°42′02″E; 12 July 1998; Reza Azmi RA 12798 B (SAN) • Ranau, Tawaras, Toki on way to Pinousuk; [06°07′10″N, 116°47′56″E]; 185.806 m (2000 ft.) elev.; 3 November 1959; W. Meijer SAN 20294 (SAN) • Ranau, Tenompok, Mount Kinabalu, Kundasang; [05°58′58″N, 116°30′40″E]; 1330 m elev.; 8 April 1932; Clemens & Clemens 29136 (L) • Ranau, Ulu Tungud Forest Reserve, Gunung Mongkobo Expidition, Sungai Parangampang; 05°50′04″N, 116°59′41″E; 417 m elev.; 29 July 2005; Saw SAN 145957 (SAN).

Identification. *Ooia kinabaluensis* is extremely variable in size vegetatively and is defined by fragrant inflorescences, a persistent spadix axis, deciduous flowers with the pistillate flowers inserted on a conspicuous swollen cushion, parietal placentation, a spathe completely persistent to persistent more than half its length, with the persistent portion ovoid-subcylindric to fusiform or funnelform, and never flaring, and production of copious

plantlets from the finer roots (with a conspicuous mucigel cap to the roots) (Bogner and Hay 2000).

Distribution and ecology. Kinabalu range. Facultatively rheophytic, lithophytic or terrestrial in shade, 750–2300 m elev.

***Phymatarum borneense* M.Hotta**

Material examined. MALAYSIA – **Pedalaman** • Beaufort, beside road mile 58; 05°20′32″N, 115°46′28″E; 15 December 1989; Amin SAN 114925 (SAN).

Identification. *Phymatarum borneense* is defined by a constricted spathe, with the lower persistent part actively splitting-opening at fruit maturity, unistaminate flowers with large densely papillate thecae, sharply downturned needle-like thecae extensions dehiscing by an apical pore, and pollen in droplets (Low et al. 2018).

Distribution and ecology. This is a first record for Sabah (Jyloerica et al. in review). Eastern Sabah. Rheophytic, occasionally terrestrial on very wet forest floor, in deep shade at low elevation.

***Pothos atropurpurascens* M.Hotta**

Figure 5C

Material examined. MALAYSIA – **Pantai Barat** • Ranau, Mount Kinabalu, Penibukan; 06°05′30″N, 116° 32′45″E; 16 January 1933; Clemens & Clemens 31126 (A) – **Sandakan** • Telupid-Ranau Road, Mile 8 Telupid Ranau Road; [05°39′24″N, 117°04′15″E]; 22 March 1974; Aban & Saikeh SAN 79445 (SAN) • Sandakan, Sepilok Forest Reserve; [05°49′36″N, 117°57′04″E]; 22 April 1960; W. Meijer SAN 21234 (SAN).

Identification. *Pothos atropurpurascens* belongs to subgenus *Allopothos*, the Barberianus group where the species are characterized by thickened, often sharply deflexed long peduncles and often cucullate, somewhat leathery spathes (Boyce 2000).

Distribution and ecology. Northwest and northeastern Sabah. Primary to disturbed secondary lowland to upper hill forest, occasionally on ultramafics, 125–1230 m elev.

***Pothos barberianus* Schott**

Material examined. MALAYSIA – **Pedalaman** • Tambunan, Gunung Alab; [05°49′51″N, 116°20′23″E], 1300 m elev.; 22 February 1969, H. P. Nooteboom 999A (L) – **Pantai Barat** • Kota Belud, Mt Templer Forest Reserve, South of Sungai Talupit; [06°24′10″N, 116°36′39″E]; 548.64 m (1800 ft.) elev.; 26 September 1972; G. Shea & F. Minjulu SAN 76257 (SAN) – **Sandakan** • Beluran, Labuk & Sugut, Doji, western side of Bt. Doji and pass way from Telupid to Ulu Karamuak, Bt. Doji, Telupid; [05°37′39″N, 117°6′45″E]; 100 m elev.; 24 October 1968; Kokawa & Hotta 413 (L) • Kinabatangan, Karamuak, Sungai Kerang; [05°N, 115°45′E]; 1 September 1970; Kumin Muroh SAN 70601 (SAN) • Sandakan, Bidu-Bidu Hills, Bidu-bidu Hills above Kiabau; 05°50′49″N, 117°15′41″E; 457.2 m elev.; 3 June 1964; W. Meijer SAN 43823 (SAN) • Sandakan, Kebun Cina; 05°51′04″N, 118°03′47″E; 30 May 1990; W. Meijer SAN 124380 (SAN) • Sandakan, Mile 17 Labuk Road; [05°53′28″N, 117°55′9″E]; 26 March 1963; Mukmin Asir SAN 35621 (SAN) – **Tawau** • Lahad Datu, Madai Forest Reserve; [04°41′18″N, 118°01′55″E]; 6 August 1993; Martin Sands & K. M. Wong 6033 (SAN).

Identification. *Pothos barberianus* belongs to subgenus *Allopothos*, the Barberianus group. It can be detected easily from its inflorescence pendent by the sharply reflexed peduncle, spathe strongly reflexed and spadix only just exceeding the greatly enlarged peduncle (Boyce and Hay 2001).

Distribution and ecology. Northwestern, southwestern, and northeastern Sabah. In a wide range of habitats from primary and disturbed lowland forest on clays to ridgetop kerangas, 10–1800 m elev.

***Pothos beccarianus* Engl.**

Material examined. MALAYSIA – **Pedalaman** • Beaufort, Bukit Montonior; [05°20′56″N, 115°48′10″E]; 27 October 1975; Dewol & Karim SAN 80276 (SAN) • Keningau, Ulu Sungai Tinagalan Forest Reserve; 05°5′35″N, 116°18′12″E; 20 November 1985; Fidilis Krispinus SAN 113123 (SAN) • Keningau, Tulid Area, Ulu Sungai Sembauan, 05°19′15″N, 116°25′27″E; 20 September 1988 Fidilis Krispinus SAN 125636 (SAN) – **Sandakan** • Kinabatangan, Penangah Forest Reserve, 05°01′45″N, 116°43′14″E; 27 April 1987; Joseph B., Maidil & Gambio SAN 119084 (SAN).

Identification. *Pothos beccarianus* is endemic to Borneo (not yet recorded from Kalimantan) and belongs to the Goniurus supergroup. *Pothos beccarianus* is recognized for its frequently long, pubescent inflorescences with the flowers set directly on the spadix axis and not on a swollen pad. This species is variable in size and the development of its inflorescence is closely linked to the vigour of the plant or even of an individual branch (300% size difference). *Pothos beccarianus* has two different types of inflorescences colour, yellow (common) and dark pink (rare) (Boyce and Hay 2001).

Distribution and ecology. Southwestern and northeastern Sabah. Primary to variously disturbed lowland to hill forest, on slopes and ridgetops, very occasionally in kerangas, 135–820 m elev.

***Pothos brevistylus* Engl.**

Material examined. MALAYSIA – **Pedalaman** • Beaufort, Klias Forest Reserve; 05°17′47″N, 115°37′50″E; 20 July 1993; Dewol & Karim SAN 77798 (SAN) – **Sandakan** • Kinabatangan, Bukit Garam, Sungai PSN, Block 13; 05°29′25″N, 117°49′38″E; 14 December 1990; Shim Phyau Soon SAN 131673 (K, SAN) • Kinabatangan, Pin-Supu Forest Reserve, Batu Puteh, Tulug Hill; 05°25′14″N, 117°56′25″E; 8 June 1996; S. P. Lim 626 (SAN) • same locality; 12 December 1990; W. Meijer & Dewol SAN 131635 (SAN) – **Tawau** • Lahad Datu, Segama River Forest Reserve; 04°57′42″N, 117°49′57″E; 17 March 1985;

Leopold M. & Ismail SAN 108602 (SAN) • Tawau, Luasong Camp; 04°23′59″N, 117°53′21″E; 11 July 1985; Leopold M. SAN 107943 (SAN) • Tawau, Tawau Hills Park, Bombalai Hill; 22 October 1985; Leopold M. & Sigin SAN 111552 (SAN).

Identification. *Pothos brevistylus* belongs to the Oxyphyllus group and endemic to North Borneo (Brunei, Sabah, and Sarawak). *Pothos brevistylus* approaches *Pothos laurifolius* P.C.Boyce & A.Hay (Brunei) but can be separated from its leaves, sessile stigma, spathe and synflorescences (Boyce and Hay 2001).

Distribution and ecology. Southwestern, northeastern, and eastern Sabah. Lowland forest on shale, slopes, and ridges, rarely in peatswamp, 20-80 m elev.

***Pothos cylindricus* C.Presl**

Material examined. MALAYSIA – **Sandakan** • Kinabatangan, Kampung Pangkaian, Tamogang Timber Camp near Kampung Pangkaian; [05°25′22″N, 118°14′19″E]; 20 November 1968; Kokawa & Hotta & Mitsuru Hotta 1300 (L, P) – **Tawau** • Lahad Datu, Danum Valley, side of tractor path coupe 1989; 04°57′30″N, 117°41′47″E; 23 August 1990; Maikin & Lideh SAN 131103 (SAN) • same locality; 20 June 1989; C. E. Risdale 2113 (L) • Lahad Datu, Madai-Baturong Forest Reserve; 04°41′18″N, 118°01′55″E; 9 June 1996; Madai Hill, S. P. Lim 653 (SAN) • Tawau, Bukit Gemuk; 04°18′11″N, 117°52′E; 8 August 1993; K. M. Wong et al. SAN 144814 (SAN).

Identification. *Pothos cylindricus* belongs to subgenus *Pothos*, the Junghuhnii group and is very close to *Pothos longipes* Schott but differs from its sessile spadix and flowering only terminally on leafy branches. *Pothos cylindricus* is also very near to *P. papuanus* Becc. ex Engl. (also with a sessile spadix), but *P. papuanus* usually lateral on a sometimes sympodially branched short shoot in distal leaf and the spathe oblong-ovate to oblong-lanceolate (Boyce and Hay 2001).

Distribution and ecology. Northwestern and eastern Sabah. Primary and secondary lowland to upper hill forest, often in well-drained positions, 40–900 m elev.

***Pothos fractiflexus* J.Joling, Pereira & A.Damit**

Material examined. MALAYSIA – **Pedalaman** • Sapulut, Nurod-Urod F.R.; 04°35′10″N, 116°54′27″E; 582 m elev.; 14 Jun 2012; Suzana S. SAN 154991 (SAN) – **Sandakan** • Ulu Sg. Pinangah, 04°44′45″N, 116°37′00″E; 17 Oct 1984, Patrick Lassan SAN 107216 (K, L, SAN).

Identification. In general appearance very close to *P. degenerans*, but readily differentiated by pedicellate florets and shallow saucer-like receptacle (Wong et al. 2020b).

Distribution and ecology. Endemic to Sabah. Forested hillsides on Neogene or Quaternary sediments between 300 and 500 m elev.

***Pothos insignis* Engl.**

Figure 5D

Material examined. MALAYSIA – **Pedalaman** • Keningau, Lian Cave; 05°29′30″N, 116°10′30″E; 5 June 1965; W. Meijer & John Kuripin SAN 51712 (K, L, SAN) • Nabawan, Maitland Range Area, Sungai Pingas-Pingas; 05°14′20″N, 116°40′32″E; 14 May 1986; Asik Mantor SAN 113935 (SAN) • Pandewan, Sungai Pementarian; 04°58′12″N, 116°25′24″E; 13 February 2019; Sumbing Jimpin SAN 119949 (SAN) – **Pantai Barat** • Ranau, Bukit Ampuan, hillside; [06°01′18″N, 116°39′59″E]; 792 m elev.; 20 November 1973; L. Madani SAN 89395 (SAN) • Ranau, Kinabalu; [06°04′22″N, 116°33′29″E]; 1371.6 m (4500 ft.) elev.; 16 August 1963; G. Mikil SAN 38668 (SAN) • Ranau, Poring, Sungai Kipungit; 06°02′53″, 116°42′06″E; 457.2 m (1500 ft.) elev.; 3 October 1987; W. Meijer SAN 122512 (SAN) – **Sandakan** • Kinabatangan, Tabin Wildlife Reserve, northern part near Tabin River; 05°19′N, 118°45′E; 19 October 2000; 180 m elev.; A. D. Poulsen 1678 (AAU, BORH, K, KEP, L, SAN, SING) • Sandakan, Gomantong Forest Reserve, Dulong Lambu; 05°33′30″N, 118°06′30″E; 100 m elev.; 28 April 1996; S.P. Lim 584 (SAN) • Sandakan, Ulu Dusun, Mile 30; [05°47′06″N, 117°46′14″E]; 15.24 (50 ft.) elev.; 18 August 1977; S. Lantoh SAN 87859 (KEP, SAN, SAR).

Identification. *Pothos insignis* is apparently allied to *P. rumphii* Schott and *P. borneensis* Furt. in having long petioles with a petiolar sheath extending to the base of the geniculum, a relatively large, leathery spathe and robust tepals. *Pothos insignis* is distinguished from *P. rumphii* and *P. borneensis* by the manner in which the inflorescences are presented. In *P. insignis* new fertile stems arise from leafess, post fertile stems. The new fertile stems are clothed along their entire length by inflated cataphylls each consisting of a greatly enlarged petiolar sheath terminated by a much-reduced leaf blade. From the apex of each fertile stem emerge the inflorescences, one at a time, each new inflorescence emerging as the previous one begins to fruit. It is unclear how many inflorescences a fertile stem produces before it dies, but a study of the scarring of post fertile stems suggest that it may be as many as 12 (Boyce and Poulsen 1993).

Distribution and ecology. Northwestern, southwestern, and northeastern Sabah. Lianescent, hemi-epiphytic or lithophytic trunk or treelet climber at base of ridges or near rivers in primary to disturbed primary mixed dipterocarp forest on shales or limestone, at 10–1200 m elev.

***Pothos kinabaluensis* Furtado**

Material examined. MALAYSIA – **Pantai Barat** • Kinabalu, Mts. At Tenompok, ca. 5000 ft elev. (leg. Furtado, comm. Clemens sub. N. 29,155) (holo SING).

Identification. The species is related to *P. lancifolius* Hook.f., but differentiated by the sessile spadix, and by the much larger leaf blades with three collective veins, the longer petiole, and the wider petiolar sheath (Furtado 1935). This foliage is very similar to that of *P. insignis*, but the latter has a unique flowering architecture (P.C. Boyce, pers. comm.).

Distribution and ecology. This species in endemic

to Sabah. Known from its type locality at Tenompok. Mixed dipterocarp forest on slopes, ridges and streambanks on clay, sandstone, and shale.

***Pothos leptostachyus* Schott**

Figure 5E

Material examined. MALAYSIA – **Pedalaman** • Tenom, Alutok; 04°39′27″N, 115°51′33″E; 17 March 1987; Fidilis Krispinus SAN 120163 (SAN) – **Sandakan** • Kinabatangan, Gomantong Caves; 05°31′52″N, 118°04′17″E; 300 m elev.; 24 April 1996; A. Hay 12166 (SAN) • Kinabatangan, Tabin Wildlife Reserve, northern part near Tabin River; 05°19′N, 118°45′E; 180 m elev.; 19 October 2000; A. D. Poulsen, Jens Kanstrup & Kho Ju Ming, A.D.Poulsen 1677 (SAN) • Sandakan, Gomantong Caves; 31 October 1968; Kokawa, S. & Hotta, M. S. Kokawa 572 (L) • Sandakan, Gomantong Forest Reserve, Dulong Lambu limestone massif, Gomantong limestone hill; 50 m elev.; 28 April 1996; S. P. Lim et al. LSP 576 (SAN).

Identification. This species belongs to the *Allopothos* supergroup together with *P. kingii* Hook.f. *Pothos leptostachyus* and *P. kingii* have thinly chartaceous leaves. The stout (2–3 mm in diameter) erect peduncles and longer, lorate spathe readily distinguishes *P. leptostachyus* (Boyce 2009).

Distribution and ecology. *Pothos leptostachyus* is a new record for Sabah. Damp to rather dry evergreen hill forest on limestone, 50–300 m elev.

***Pothos longivaginatus* Alderw.**

Material examined. MALAYSIA – **Tawau** • Tawau, Elphinstone Province, [04°18′N, 117°54′E]; October 1922; A. D. E. Elmer 21822 (L).

Identification. *Pothos longivaginatus* is distinguished by the long petiolar sheath, almost reaching the geniculum. The leaf blade is thickly leathery, obliquely lanceolate, unequal on boths sides. The peduncle is longer than the petiole with a sessile spadix (Alderwerelt 1920).

Distribution and ecology. Northwestern and eastern Sabah. Mixed dipterocarp forest on slopes, ridges and streambanks on clay, sandstone, and shale, 23–1525 m elev.

***Pothos mirabilis* Merr.**

Figure 5F

Material examined. MALAYSIA – **Sandakan** • Sandakan, Myburgh Prov.; [05°51′19″N, 117°53′4″E]; October 1921; A. D. E. Elmer 20364 (L) • Sandakan, Labuk Sugut, below Bukit Panandawan; 06°10′53″N, 117°35′48″E; 25 September 1984; G. Aban SAN 66890 (SAN).

Identification. *Pothos mirabilis* is endemic to Sabah and is unique from its flower, its enormously elongated and twisted pendent spathe. *Pothos mirabilis* is allied to *Pothos volans* P.C.Boyce & A.Hay and *Pothos wallichii* Hook.f. due to its inflorescences are mostly produced from the tips of leafy shoots and this together with the long slender peduncle (Boyce 2000).

Distribution and ecology. Endemic to Sabah. Lowland forest on yellow sandy loam, 20–300 m elev.

***Pothos motleyanus* Schott**

Material examined. MALAYSIA – **Federal Territory of Labuan** • P. Labuan; Motley 99 (holo K).

Identification. *Pothos motleyanus* belongs to the Goniurus supergroup (Boyce & Hay 2001), with the spadix with scattered flowers. Inflorescences carried on much abbreviated stems clothed in minute cataphylls and arising from the mid-parts (rarely the tips) of sterile mature stems. In *P. curtisii* these lateral shoots arise from beneath the leaf axil (or node) and are elaborated by sympodial branching into leafless, sometimes highly complex, compact, or lax synflorescences bearing two to many inflorescences simultaneously, or sometimes single inflorescences in series. Synflorescences are usually borne along or at the end of leafy branches or, more rarely on older leafless parts of the stem.

Distribution and ecology. Endemic to Sabah. The type is from Labuan and the species has not been refound anywhere in Sabah, Sarawak, and Brunei.

***Pothos ovatifolius* Engl.**

Figure 5G

Material examined. MALAYSIA – **Pantai Barat** • Tambunan Distr., road to Kg Tondulu, Kg Tondulu valley; Boyce 1422 (K) • Tambunan Distr., Kg Kangeran road, Bt. Lapan, 1.5 hours by car from Kg Kangeran; Boyce 1423 (K).

Identification. This species belongs to the Allopothos supergroup (Boyce and Hay 2001) and can be distinguished by its leaf blade stiffly chartaceous to coriaceous, (3–)8.5–27 × (2.5–)7–27 cm, spreading, oblong ovate to very broadly ovate, oblique, sometimes profoundly so, base broadly rounded to narrowly cordate.

Distribution and ecology. Found in small, scattered populations in wet river valleys in Sabah. This species is not common in northern Borneo. Primary to degraded secondary lowland to lower montane forest, 70–1400 m elev.

***Pothos scandens* L.**

Figure 5H

Material examined. MALAYSIA – **Pedalaman** • Tambunan, Junction Sungai Tikalod; 06°01′12″N, 116°47′55″E; 23 April 1986; George Majawat, SAN 114312 (SAN) – **Pantai Barat** • Ranau, Mount Kinabalu, Dallas; 06°05′30″N, 116°32′45″E; 27 October 1931; Clemens & Clemens 26808 (P) • Ranau, Singgaron Baru, Marali side; 06°01′12″N, 116°47′55″E; 914.4 m (3000 ft.) elev.; 23 April 1986; Amin Gambating SAN 114312 (SAN) – **Sandakan** • Sandakan, Segaliud Lokan Forest Reserve, Lungmanis 1969 Coupe L, Kolapis Road; [05°31′45″N, 117°32′02″E]; 22 May 1970; C. Charington SAN 63644 (SAN) – **Tawau** • Lahad Datu, Silam; [05°51′19″N, 117°53′04″E]; 121.92 m (400 ft.) elev.; 21 August 1961; Muin Chai SAN 26034 (SAN, K) • Lahad Datu, Ulu

Sungai Segama; 04°57′24″N, 117°37′03″E; 3 March 1985; G. Argent et al. SAN 107698 (SAN) • Tawau, Bukit Gemuk, [04°18′N, 117°52′E]; 8 August 1993; K. M. Wong, Baraham & Kumin SAN 134814 (SAN).

Identification. *Pothos scandens* is highly variable, the plant bears small inflorescences on bent peduncles, it can be high-climbing plants bearing tiny inflorescences, some may have large inflorescences not exhibiting the bent peduncle until very late anthesis or during early infructescence development, the large inflorescences of *P. scandens* can be mistaken with *P. roxburghii* de Vriese (Boyce 2000).

Distribution and ecology. Northwestern, Southwestern, northeastern, and eastern Sabah. On trees and rocks in primary and secondary wet to dry lowland to hill evergreen tropical to subtropical forest, occasionally on sea cliffs, in hedges or scrub or in coconut plantations, on a variety of substrates including clay, limestone and granite. Sea-level to 1000 m elev.

***Pursegloveia imbakensis* H.Okada, Tsukaya & M.Suleiman**

Material examined. MALAYSIA – **Sandakan** • Tongod, Imbak Canyon Conservation Area, Kuli Water Fall; 8 Aug. 2015; Tsukaya, H., Okada, H., Hayashi, T. & Suleiman, M. TOH-113 (holo BORH).

Identification. Similar to *Pursegloveia minima* (H.Okada) S.Y.Wong & P.C.Boyce in having stamens with shallow cavity but differing in the horseshoe-shaped staminate flowers and shining dark green leaves 20–30 cm long vs. chain-shaped staminate flowers and shining green leaves 4–7 cm long in *P. minima* (Okada et al. 2020).

Distribution and ecology. Known only from the type locality at Kuli Waterfall, Imbak Canyon Conservation Area. Observed only on a large rock just below Kuli Waterfall (Okada et al. 2020).

***Rhaphidophora fluminea* Ridl.**

Material examined. MALAYSIA – **Pedalaman** • Keningau, Camp C area Tiulan; 05°07′31″N, 116°23′02″E; 31 October 1983; Maikin Lantoh SAN 102053 (SAN) • Keningau, Lanas, Shang Lian logging area; 05°25′03″N, 116°29′28″E; 21 October 1986; Fidilis Krispinus SAN 118444 (SAN) • Keningau, Ulu Sungai Matud; 05°12′N, 116°06′E; 29 June 1987; Shawn Tangki SAN 119596 (SAN) • Keningau, Ulu Sungai Pingas-Pingas, along the riversides; 05°14′20″N, 116°40′32″E; 8 March 1988; Sumbing Jimpin SAN 122024 (SAN) • Pensiangan, logged areas, Ponontomon; 05°01′21″N, 115°57′15″E; 23 September 1989; Sumbing Jimpin SAN 128024 (SAN) • Pensiangan, Pensiangan Kayu; 04°52′02″N, 116°16′53″E; 21 January 1994; Asik Mantor SAN 136885 (SAN) – **Pantai Barat** • Ranau, Kampung Paus, edge of riverbank; 05°41′12″N, 116°47′02″E; 23 February 1982; Amin G. SAN 94681 (SAN) – **Sandakan** • Beluran, Labuk & Sugut, Doji, western side of Bt. Doji and pass way from Telupid to Ulu Karamuak; [05°37′42″N, 117°06′48″E]; 100 m elev.; 25 October 1968; Kokawa & Hotta 471 (L) • Beluran, Sungai Baba; 05°45′01″N, 117°08′40″E; 1 March 1980; Aban G. SAN 90040 (SAN) • Kinabatangan, Imbak Canyon; 05°07′N, 116°58′E; 160 m elev.; 15 May 2004; H. Nagamasu 7278 (K, KEP, KYO, L) • Sandakan, Babakang River, VJR Mile 42; 05°06′42″N, 118°59′39″E; 16 December 1985; Lideh et al. SAN 118056 (SAN) • Sandakan, Labuk & Sugut, along Sungai Meliau, foot of Mt. Tawai, Telupid; [05°30′33″N, 117°3′54″E]; 20 October 1968; Kokawa & Hotta 110 (L) • Sandakan, Labuk Road Mile 45; [05°41′57″N, 117°36′12″E]; 26 July 1964; W. Meijer SAN 44014 (K, L, SAN) • Sandakan, Labuk Sugut, Ulu Tungud, Ensuan; 05°47′20″N, 117°07′58″E; 26 January 1987; Amin K. & Mansus SAN 117025 (SAN) • Sandakan, Lamag, Sungai Lokan; [05°29′51″N, 117°20′03″E]; 5 June 1983; Amin K. et al. SAN 97483 (SAN) • Sandakan, Lamag, Ulu Sungai Lokan, side of streams on rocks; [05°29′51″N, 117°20′03″E]; 8 November 1979; Aban G. & Petrus SAN 90675 (SAN) • Sandakan, Lungmanis, Virgin Jungle Reserve 45 A; 05°38′40″N, 117°43′25″E, 19 December 1985; Dewol S. et al. SAN 118075 (SAN) • Sandakan, Sepilok Forest Reserve; 05°49′36″N, 117°57′04″E; 17 January 1989; Kessler SAN 118160 (SAN) • Sandakan, Trail to Ulu Sungai Tariu, Kampung Wonod; [05°38′38″N, 117°05′24″E]; 14 March 1974; Aban G. & Saikeh, SAN 79387 (SAN) • Telupid, Penangah Forest Reserve; 4°58′41″N, 116°52′11″E; 20 July 1993; Fidilis K. SAN 135710 (SAN) • Telupid, VJR Ulu Sungai Sapapayau, at riverbank of Sungai Merah; 05°30′N, 118°30′E; 15 October 1985; Dewol S. et al. SAN 109519 (SAN) – **Tawau** • Kalabakan, Batu Timbang VJR, 06°27′14″N 116°48′07″E; 12 March 2015, Ubaldus, M. & Tawadong, T. SAN 157055 (KEP, SAN).

Identification. *Rhaphidophora fluminea* is differentiated from *R. beccarii* Engl. (both species are rheophytes) by having falcate, narrow, entire leaf blades and a bright yellow spathe and spadix vs. mature leaf blade pinnatifid to pinnatisect and a creamy yellow spathe and spadix.

Distribution and ecology. *Rhaphidophora fluminea* is endemic to Sabah. Widespread. Occurs on exposed mud near river.

***Rhaphidophora korthalsii* Schott**

Material examined. MALAYSIA – **Pedalaman** • Tenom, Malutut, north ridge of Mt. Malutut, ca. 15 km N of Tenom; [05°15′11″N, 115°55′28″E]; 450 m elev.; 21 December 1968; Kokawa & Hotta 2455 (L) • Tenom, Sungai kaang; 05°08′54″N, 115°58′27″E; 28 March 1987; Asik Mantor SAN 120296 (SAN) – **Pantai Barat** • Penampang, Tungol, Togudon KM48 Jalan Tambunan/ Penampang; 05°46′48″N, 116°20′43″E; 24 August 1989; Sumbing J. SAN 127801 (SAN) • Ranau, Bukit Kulung, 06°01′26″N, 116°40′18″E; 6 October 1987; W. Meijer SAN 122429 (SAN) • Ranau, Bundu Tuhan Forest Reserve; 05°58′58″N, 116°32′32″E; 1371.6 m (4500 ft.) elev.; 28 June 1994; J. T. Pereira 9 (K, KEP, SAN) • Ranau, Kinabalu

Road to Mesilau; [06°02′41″N, 116°35′44″E]; 1219.2 m (4000 ft.) elev.; 16 August 1963; G. Mikil SAN 38691 (SAN) • Ranau, Mount Kinabalu, Dallas; [06°05′30″N, 116°32′45″E]; 914.4 m (3000 ft.) elev.; 15 September 1931; Clemens & Clemens 26495 (P) • Ranau, Mount Kinabalu, Penataran, Penataran River; [06°05′30″N, 116°32′45″E]; 914 m elev.; 28 July 1933; Clemens & Clemens 34298 (L) • Ranau, Mount Kinabalu, Silau Basin; [06°05′30″N, 116°32′45″E]; 1828.8 m elev.; 8 April 1932; C. X. Furtado 29146A (L, SAR) • Ranau, Mount Kinabalu, Upper Kinabalu; [06°05′30″N, 116°32′45″E]; 1829 m elev.; 8 April 1932; Clemens & Clemens 29146 (L) – **Sandakan** • Kinabatangan, Lamag, Batu Puteh; [05°25′14″N, 117°56′25″E]; 16 February 1978; G. Majawat & P. Lassan SAN 88017 (SAN) • Kinabatangan, Lamag, Sungai Pin; [05°21′19″N, 117°55′55″E]; 29 November 1978; Dewol S. & Harun T. SAN 89922 (SAN) • Kinabatangan, Tabin wildlife Reserve, Northern Part Near Tabin River, Valley behind limestone ridge toward Bukit Quion; 05°19′N, 118°45′E; 180 m elev.; 21 October 2000; A. D. Poulsen 1680 (SAN, KEP, AAU, K) • Sandakan, Batu 15 Sepilok; [05°53′28″N, 117°56′08″E]; 24 November 1961; W. Meijer SAN 28394 (SAN) • Sandakan, Gomantong Forest Reserve, Dulong Lambu limestone massif, Gomantong limestone hill, dry cliff; 05°33′30″N, 118°06′30″E; 200 m elev.; 28 April 1996; S. P. Lim 591 (SAN) • Sandakan, Labuk Road, Mile 15; [05°53′20″N, 117°56′41″E]; 17 March 1949; A. Cuadra A 2237 (SAN) • Sandakan, Segaliud Lokan Forest Reserve; [05°31′45″N, 117°32′02″E]; 23 January 1975; Aban G. SAN 80977 (SAN) • Telupid, Tawai Hill; 05°31′51″N, 117°06′17″E; 19 October 1985; Dewol et al. SAN 109574 (SAN) – **Tawau** • Lahad Datu, Madai-Baturong Forest Reserve Madai Hill; 04°41′18″N; 118°1′55″E; 9 June 1996; S. P. Lim 654 (SAN) • same loacality; S. P. Lim 706 (SAN) • Lahad Datu, Malua Forest Reserve; 05°04′54″N, 117°38′23″E; 4 August 1990; Dewol S. SAN 129751 (SAN) • Lahad Datu, Ulu Sungai Danum North of Camp 111; [04°56′00″N, 117°29′45″E]; 9 September 1976; B.C. Stone et al. SAN 85310 (SAN) • Lahad Datu, Ulu Sungai Danum S. of Camp 3; [04°56′00″N, 117°29′45″E]; 2 September 1976; B. C. Stone et al. SAN 85269 (SAN) • Lahad Datu, Ulu Sungai Danum, growing on ridge NE of camp site; [04°56′00″N, 117°29′45″E]; 426.72 m (1400 ft.) elev.; 28 August 1976; Lantoh SAN 85121 (SAN) • Semporna, Bohey Dulang Island; 04°35′59″N, 118°47′04″E; 50 m elev.; 13 October 1998; J. B. Sugau et al. SIP-G 29 (SAN) • Tawau, Luasong camp Luasong camps N.B.T., about 60 KM NW of Tawau; [04°36′23″N, 117°24′03″E]; 100 m elev.; 7 November 1968; Kokawa & Hotta 797 (P).

Identification. The pre-adult stage of *R. korthalsii* may prove difficult to distinguish from *Epipremnum pinnatum* due to limited herbarium collection. However, *R. korthalsii* can be distinguished from *Epipremnum pinnatum* from its stems lacking the prominent irregular whitish longitudinal crests, the feeding roots are prominently scaly, the shape of the round style apex, the punctiform and circumferential of the stigma, and the fruits each contain many small, ellipsoid seeds with a brittle, smooth testa (Boyce 1999).

Distribution and ecology. Widespread. Primary to disturbed secondary lowland, hill and montane forest, moss forest, peatswamp forest, on trees, rocks, and cliffs on a variety of substrates including limestone and ultrabasic soils. 20–1800 m elev.

Rhaphidophora latevaginata M.Hotta

Material examined. MALAYSIA – **Pantai Barat** • Penampang, Moyog, along road between Kota Kinabalu and Tambunan, 21 miles SE of Kota Kinabalu, W slopes of Crocker Range; 05°50′N, 116°14′E; 460 m elev.; 26 September 1981; T. B. Croat 53118 (MO, SAR) • Ranau, Bukit Kulung; 06°01′26″N, 116°40′18″E; 6 October 1987; W. Meijer SAN 122414 (SAN) – **Sandakan** • Sandakan, Phenological Trail Above Sawmill; 05°51′19″N, 117°53′04″E; 60.96-91.44 m (200 ft.-300 ft.) elev.; 15 December 1990; Dewol & Meijer SAN 131653 (SAN).

Identification. The juvenile and pre-adult stages of *R. latevaginata* and *R. korthalsii* are superficially similar and to non-specialist difficult to differentiate. *Rhaphidophora latevaginata* has petiolar sheath that is long-persistent (vs. very rapidly marcescent), mostly adnate (vs. mostly free) with the wings strongly unequal (vs. weakly or not at all unequal), shortly free-auriculate (vs. long, narrowly triangular free-ligulate) and petiole of *R. latevaginata* proportionately longer (petiole: blade ca. 1:5 vs. ca. 1:12) (Ahmad Sofiman and Boyce 2010).

Distribution and ecology. Northwest and northeastern Sabah. Primary to secondary moist lowland to hill dipterocarp forest on clay and sandstone. 50–840 m elev.

Rhaphidophora lobbii Schott

Material examined. MALAYSIA – **Pantai Barat** • Ranau, Ulu Tungud Forest reserve, Gunung Monkobo expedition, Sungai Kiberibi; 05°50′57″N, 116°59′17″E; 324 m elev.; 23 July 2005; Saw L. G. et al. SAN 146651 (KEP, SAN, SAR) – **Sandakan** • Kinabatangan, Kampung Pangkaian, Tamegang Timber Camp near Kpg. Pangkaian; [05°25′22″N, 118°14′19″E]; 22 November 1968; Kokawa & Hotta 1417 (L) • Kinabatangan, Pin-Supu Forest Reserve, Batu Puteh, Supu Hill; 05°25′14″N, 117°56′25″E; 13 June 1996; S. P. Lim 766 (SAN) • Sandakan, below waterfall Kebun Cina Forest Research centre; 05°50′46″N, 118°05′08″E; 20 December 1990; W. Meijer & Dewol S. SAN 131749 (SAN) • Sandakan, Labuk Road; [05°50′13″N; 118°06′53″E]; 182.88 m (600 ft.) elev.; 26 August 1963; W. Meijer SAN 38784 (SAN) • Sandakan, Sepilok Forest Reserve; 05°49′36″N, 117°57′04″E; 24 May 1982; Amin G. SAN 94588 (SAN) • Sandakan, Sungai Dagat, lowland forest; 05°24′42″N, 118°47′42″E; 17 July 1987; George et al. SAN 120521 (SAN) • Sandakan, Sapi Virgin Forest Reserve; 05°49′30″N, 117°25′30″E; 25 June 2007; Pius G. et al. SAN 148862 (SAN).

Identification. *Rhaphidophora lobbii* have combination of characters unknown in any other Malesian

Rhaphidophora, the slender, asperous stems, softly leathery leaves and minutely puberulent spathe exterior. In dry material the leaves discolorous strongly and the primary veins prominently darker than the abaxial leaf surface (Boyce 2001).

Distribution and ecology. Northwestern and northeastern Sabah. Primary to disturbed secondary lowland dipterocarp and peatswamp forest on wet to inundated soils, 250 m elev.

Rhaphidophora minor* Hook.*f.

Material examined. MALAYSIA – **Sandakan** • Beluran, Bongaya Forest Reserve; [05°45′00″N, 117°24′00″E]; 15.24 m (50 ft.) elev.; 22 July 1975; Kodoh & Aban G. SAN 82024 (SAN) • Beluran, Sungai Mengkayok near Sungai Kalagan; [06°00′46″N, 117°33′06″E]; 16 May 1965; W. Meijer SAN 51617 (SAN).

Identification. *Rhaphidophora minor* may look similar to *R. sylvestris* (Blume) Engl. when it is fresh, although the thinner, more prominently veined leaf and longer spathe beak of *R. minor* are diagnostic. Dried material of *R. minor* is notable for the uniformly pale straw-coloured leaves (Boyce 2001).

Distribution and ecology. Northeastern Sabah. Swampy habitats in full sun, often along the banks of large rivers. Sea level to 10 m elev.

***Rhaphidophora puberula* Engl.**

Material examined. MALAYSIA – **Pedalaman** • Keningau, Sungai Labou; 05°22′09″N, 116°29′32″E; 4 June 1985; Asik Mantor SAN 110980 (SAN) • Kunak, Madai, Madai Caves, Madai Baturong Forest Reserve; [04°43′45″N, 118°08′00″E], 100 m elev.; 14 November 1968, Kokawa & Hotta 1097 (L) • Pensiangan, Pandewan, Sungai Mesopo, along the riverside; 04°51′31″N, 116°34′48″E; 18 February 1986; Fidilis & Sumbing SAN 113389 (SAN) • Pensiangan, Pensiangan Utara, Kampung Batu, Bukit Pun Batu; 04°47′30″N, 116°11′33″E; 24 October 1996; S. P. Lim 1501 (SAN) – **Pantai Barat** • Penampang, Sugud Recreation Park; 05°50′13″N, 116°06′48″E; 365.76 m (1200 ft.) 29 August 1993; Madani, L. SAN 134070 (L) • Ranau, Mount Kinabalu, along road to summit; 06°04′N, 116°27′E; 2000-2300 m elev.; 27 September 1981; T. B. Croat 53131 (SAR, MO) • Ranau, Mount Kinabalu, Dallas; [06°5′30″N, 116°32′45″E]; 914.4 m (3000 ft.) elev.; 16 September 1931; Clemens & Clemens 26453 (L) • same locality; 27 October 1931; Clemens & Clemens 26876 (L) • same locality; 1371 m elev.; 27 March 1932; Clemens & Clemens 26900 (L) • Ranau, Nalumad, Monkodou River; 06°06′02″N, 116°44′29″E; 19 July 1994; W. Meijer SAN 141633 (SAN) – **Sandakan** • Kinabatangan, Kampung Pangkaian, Tamegang Timber Camp; 05°25′22″N, 118°14′19″E; 22 November 1968; Kokawa & Hotta 1416 (L) • Kinabatangan, Lamag, Ulu Sungai Pin, growing on huge rock; 05°23′28″N, 117°52′48″E; 18 September 1979; Leopold M. & F. Saigol SAN 90180 (SAN) • Sandakan, Sungai Batang off Sungai Manila Road; 05°55′18″N, 117°58′27″E; 15 March 1965; W. Meijer & Kodoh SAN 49805 (SAN) • Tongod, Maliau Valley, Belian Camp; 4°50′56″N, 116°50′28″E; 250 m elev.; 16 July 2001; Postar, Ubaldus, de Wilde et al. SAN 144149 (K, KEP, L, SAR) – **Tawau** • Kalabakan, Luasong Camp, KM 41 Imbak Road; 04°37′00″N, 117°24′18″E; 22 February 1983; Fedilis K. SAN 95680 (SAN) • Lahad Datu, Segama, Borneo Marble Quarry; 04°58′42″N, 118°13′46″E; 27 August 1999; Diwol Sundaling et al. SAN 141862 (SAN, SING) • Lahad Datu, Sungai Tabin Wildlife Centre; 05°14′30″N, 118°50′16″E; 11 August 1991; L. Madani SAN 132607 (SAN) • Tawau, Elpinstone province; [04°30′34″N, 117°33′13″E′]; 26 March 1929; A. D. E. Elmer 21593 (L) • Tawau, Sabah Foundation Logging Area, Umas-Umas; [04°27′09″N, 117°42′27″E]; 8 July 1977; Fedilis. K. SAN 87213 (SAN).

Identification. *Rhaphidophora puberula* resembles *R. foraminifera* (Engl.) Engl., especially in the perforate-leaf forms and can be differentiated from *R. foraminifera* from its inflorescence on free lateral shoots and in having the active shoot tips without the characteristic black mucilage of *R. foraminifera*. Generally, flowering plants of the perforate-leaved forms of *R. puberula* have smaller leaves that are noticeably less perforated than those of *R. foraminifera* (Boyce 2001).

Distribution and ecology. Nortwestern, southwestern, and northwestern Sabah. On trees and rocks in primary and secondary lowland to lower upper montane transition forest, often on steep slopes, on granite and limestone. 90–1550 m elev.

***Rhaphidophora sylvestris* (Blume) Engl.**

Material examined. MALAYSIA – **Pantai Barat** • Ranau Tenompok; 1524 m elev.; 14 April 1932; Clemens & Clemens 29227 (L, P) • Ranau, Bukit Hampuan; 06°00′53″N, 116°41′50″E; 17 November 1987; Amin & Jarius SAN 121155 (SAN) • Ranau, Mount Kinabalu-Mesilau Valley; [05°59′11″N, 116°36′17″E]; 1524 m (5000 ft.) elev.; 29 September 1972; Cockburn SAN 70108 (SAN) • Ranau, Mount Kinabalu, Dallas; [06°5′30″N, 116°32′45″E]; 2 November 1931; Clemens & Clemens 26921 (L) • same locality, 914.4 m (3000 ft.) elev.; 10 November 1931, Clemens & Clemens 27030 (L) • same locality; 1828.8-4114.8 m (6000-13500 ft.) elev.; 8 April 1932, C.X.Furtado 28487 (L).

Identification. *Rhaphidophora sylvestris* is more variable in Borneo than in other parts of its range (e.g., Peninsular Malaysia, Java) but the paucity of collections coupled with more or less continuous variation makes it impossible to be confident that more than one species is involved. Of particular notes is the occurrence of plants with coriaceous leaf blades that have variously been described as *Rhaphidophora gratissima* Becc. (syn. *R. sylvestris* var. *obtusata* Engl.) and *R. nigrescens* Ridl. Such plants approach *R. conocephala* Alderw. in appearance (and also resemble non-Bornean *R. crassifolia* Hook.f.), although the flat-topped styles readily distinguish them

from *R. conocephala*, while the juvenile shoots without conspicuously twisted stems separate them from *R. crassifolia*. Leaf blade thickness is not a consistent character, even between duplicates of the same collection (Boyce 2001).

Distribution and ecology. Northwestern Sabah. Primary to disturbed secondary lowland to lower montane forest on a variety of substrates including sandy loam and limestone. 120–1800 m elev.

***Rhynchopyle loi* (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce**

Figure 6A

Material examined. MALAYSIA – **Tawau** • Tawau Hills Park, trail to Bukit Gelas; 04°23′59″N, 117°53′21″E; 25 November 1998; J. T. Pereira 551 (SAN) • Tawau, Tawau Hills Park, Bukit Gelas Waterfall; 04°23′00″N, 117°53′00″E; 30 June 2006; Julia S. SAN 147860 (SAN) • Tawau River Forest Reserve; [04°24′40″N, 117°53′28″E]; 33 m (100 ft.) elev.; 6 July 1959; W. Meijer SAN 19468 (L).

Identification. Flowering *Rhynchopyle loi* most closely resembles *R. pileata* (S.Y.Wong & P.C.Boyce) S.Y.Wong & P.C.Boyce by the deep magenta-purple strongly rostrate spathe limb. However, *R. loi* is readily differentiated by the spathe basally with a prominent ventral mentum, by the larger, centrally impressed interstice staminodes held in a zone wider than the remainder of the spadix, the stamens irregularly arranged (not carried in two rows), and the proportion- ately longer staminate flower zone. The leaves of *R. loi* are only ca. half as long as those of *R. pileata*, and much narrower; the entire plant is seldom exceeding 15 cm (Boyce and Wong 2013b).

Distribution and ecology. Endemic to Sabah. Growing on bare or moss-covered basalt waterfall rocks under perhumid lowland forest; between 200 and 300 m elevation. Typically inhabits the steep banks of muddy, meandering lowland streams and, less frequently, the floor of lowlying forest where it may be inundated in wet periods.

***Schismatoglottis ahmadii* A.Hay**

Figure 6B

Material examined. MALAYSIA – **Pedalaman** • Beaufort, Bukit Bendira; [05°22′02″N, 115°22′47″E]; 22 August 1975; Dewol Sundaling SAN 80169 (SAN) • Keningau, Kitau, Sungai Tumpason; 05°29′32″N, 116°16′26″E; 6 September 1985; L. Madani & Ismail SAN 95330 (SAN) • Tambunan, Rafflesia Forest Reserve, KM68 Tambunan Road; 05°46′37″N, 116°20′37″E; 6 September 1985; L. Madani & Ismail SAN 111284 (SAN) • Tenom, Kallang Falls; 05°8′54″N, 115°58′27″E; 300 m elev.; 4 January 1984; B. J. Wallace & L. J. Forlonge B. J. Wallace 84216 (SAN) • Tenom, Lumaku Forest Reserve, Kg Baru Jumpa; 05°05′04″N, 115°53′58″E; 469 m elev.; 22 March 2010; Suzana S. SAN 151515 (SAN) – **Pantai Barat** • Penampang, Moyog, along the road between Kota Kinabalu and Tambunan, 21 miles SE of Kota Kinabalu, W slopes of Crocker Range; 05°53′08″N, 116°14′05″E; 460 m elev.; 26 September 1981; T. B. Croat 53110 (MO, SAR) • Penampang, Stesen Inobong, slope, trail to go down the river; 05°51′24″N, 116°08′17″E; 22 July 2010; Markus G. SAN 152106 (SAN) • Ranau, between Sungai Kipungit and Sungai Langanan; 06°02′53″N; 116°42′06″E; 1 October 1987; W. Meijer SAN 119148 (SAN) • Ranau, Kinabalu Park, Route to Motung-Lotung Waterfall; 06°04′45″N, 116°32′59″E; 19 September 2007; Dolois S. KNP 14832 (SAN) • Ranau, Mesilau; 05°59′08″N, 116°36′28″E; 1524 (5000 ft.) elev.; 11 April 1964; W. L. Chew & E. J. H. Corner RSNB 4899 (SAN) • Ranau, Mount Kinabalu, Mount Kinabalu National Park, along road to summit; 06°04′N, 116°27′E; 2000–2300 m elev.; 27 September 1981; T. B. Croat 53137 (MO, SAR) • same locality; 2000–2300 m elev.; 27 September 1981; T. B. Croat 53138 (MO, SAR) • Ranau, Mount Kinabalu; Dallas; [06°05′30″N, 116°32′45″E]; 914.4 m (3000 ft.) elev.; 7 August 1931; Clemens & Clemens 26024A (L)• same locality; 1700 m elev.; 27 March 1932; Clemens & Clemens 29185 (L) • same locality; 426.72 m (1400 ft.) elev.; 3 April 1932; Clemens & Clemens 29183 (L) • same locality, 1000 m elev.; Clemens & Clemens 29184 (L); same locality; 1000 m elev.; 3 April 1932, Clemens & Clemens 29188 (L, P) • Ranau, OMRD area; 06°01′25″N, 116°39′40″E; 29 August 1987; Martin SAN 122298 (SAN) • Ranau, Poring, Langana Riverside; 06°02′44″N, 116°42′02″E; 8 October 1987; Amin et al. SAN 118860 (SAN) • Ranau, Sungai Bambangan; 05°58′30″N, 116°38′45″E; 18 November 1986; Amin & Jarius SAN 116539 (SAN) • Ranau, Sungai Kipungit, Kinabalu National Park; 06°02′53″N, 116°42′06″E; 6 July 1992; W. Meijer SAN 134592 (SAN) • Ranau, Tenompok; 05°59′N, 116°30′E; 21 September 1988; Amin et al. SAN 123499 (SAN) • Ranau, Ulu Senagang; 05°21′60″N, 116°01′34″E; 566 m elev.; 18 May 2010; Markus G. SAN 151775 (SAN) – **Kudat** • Kota Marudu, Ulu Sungei-Sungei; 06°29′25″N, 116°38′38″E; 21 November 1981; Aban G. et al. SAN 94330 (SAN) – **Sandakan** • Sandakan, Gunung Rara Forest Reserve, Maliau Falls, 04°30′N, 116°45′E; 530 m elev.; 10 April 1996; Lim & Ahmad A. Hay 12060 (SAN).

Identification. *Schismatoglottis ahmadii* differs from *S. calyptrata* (Roxb.) Zoll. & Moritzi by its smaller inflorescence, larger more globose ovaries, more conspicuously flat-topped interpistillar staminodes, smaller appendix, its erect fruiting peduncle, tough primary veins, the leaves have less cordate base, numerous and closely spaced (Hay and Yuzammi 2000).

Distribution and ecology. Widespread. Facultatively rheophytic on rocks in streams and on forest floor. ca. 300–1500 m elev.

***Schismatoglottis clemensiorum* A.Hay**

Figure 6C

Material examined. MALAYSIA – **Pedalaman** • Keningau, Trus Madi Forest Reserve, side of Ulu Sungai Rampoon, 05°33′13″N, 116°31′00″E; 4 May 1988;

Figure 6. *Rhynchopyle* and *Schismatoglottis* in Sabah. **A.** *Rhynchopyle loi*. **B.** *Schismatoglottis ahmadii*. **C.** *Schismatoglottis clemensiorum*. **D.** *Schismatoglottis clivemarshii*. **E.** *Schismatoglottis moodii*. **F.** *Schismatoglottis scintillans*.

Joseph B. et al. SAN 124005 (SAN) • Sipitang, Long Pasia, Bukit Dusur, Ulu Padas, Oak Forest; 04°27′34″N, 115°44′53″E; 1125 m elev.; 27 January 2003; Dolois S. & Gusili J. SP 17697 (SAN) • Sipitang, Expidisi Ulu Padas, Bukit Dusur; 04°27′34″N, 115°44′53″E; 10 August 2018; Dolois et al., SP 17578 (SAN) • Tambunan, Gunung Alab; 05°49′43″N, 116°20′28″E; 12 August 1987; Fedilis Krispinus SAN 121675 (SAN) • Tambunan, Gunung Trus Madi; 05°33′13″N, 116°31′00″E; 13 August 1988; Asik Mantor SAN 125483 (SAN); same locality; 13 August 1988; Asik Mantor SAN 125486 (SAN) – **Pantai Barat** • Penampang, Tongudon-Tungol, KM 48 Jalan Tambunan-Penampang; 05°46′48″N, 116°20′43″E; 1300 m elev.; 11 August 1989; Asik Mantor SAN 127707 (SAN) • same locality; 1400 m elev.; 15 August 1989; Sumbing Jimpin SAN 127744 (SAN) • Penampang, Tungol Forest Reserve KM 45, Jalan Kota Kinabalu; 05°46′48″N, 116°20′43″E; 26 July 1986; Asik Mantor SAN 115787 (SAN) • same locality; 6 September 1992, Asik Mantor SAN 131313 (SAN) • same locality; 19 July 1986; Fidilis & Sumbing SAN 114613 (SAN) • Ranau, Kinabalu above Sosodopon; [06°00′15″N, 116°33′00″E]; 1524 m (5000 ft.) elev.; 2 February 1962; W. Meijer SAN 29022 (SAN) • Ranau, Tenompok, Mount Kinabalu; [05°58′58″N, 116°30′40″E]; 1700 m elev.; 15 April 1932; Clemens & Clemens 29272 (L).

Identification. *Schismatoglottis clemensiorum* resembles *S. acuminatissima* Schott (Sumatera) in leaf and habit, but differs in the large stigma and small, condensed sterile interstice (Hay and Yuzammi 2000).

Distribution and ecology. Northwestern, southwestern, and northeastern Sabah. Terrestrial in forest on slopes, ridges, and on stream banks, occasionally on rocks but not rheophytic, 1200-1600 m elev.

Schismatoglottis clivemarshii S.Y.Wong, P.C.Boyce & Kartini

Figure 6D

Material examined. MALAYSIA – **Tawau** • Lahad Datu, Danum Valley Conservation Area, Tembaling Falls trail; 05°01′01″N, 117°44′40″E; 281 m elev., 6 July 2018, Wong Sin Yeng, P.C. Boyce & Kartini Saibeh BORH 2703 (holo, SAN).

Identification. *Schismatoglottis clivemarshii* is most similar to *S. venusta* A.Hay by hapaxanthic shoots, rather coriaceous, slightly succulent leaf blades that are often variegated, a pistillate flower zone adnate to the spathe for about half its length, a staminate flower zone entirely exserted from the lower spathe chamber, thecae with the rim of the pore broken by a slit on the outer side, and by an unbroken row of staminodes along adnation of spathe and spadix. *Schismatoglottis clivemarshii* differs from *S. venusta* by glabrous petioles D-shaped in cross-section and narrowly crisped-alate on the angles (vs. minutely puberulent petioles terete in cross-section and lacking wings), by the presence of a well-defined naked sterile interstice (vs. sterile interstice ill-defined, with the apex of the pistillate flower zone attenuate and partly naked, or sometimes with a few abortive ovaries and reduced interpistillar staminodes contiguous with the base of the staminate flower zone), by a shorter, stouter pistillate flower zone, with more laxly arranged, better-defined and larger staminate flowers, and by an appendix base wider than the top of the staminate flower zone (vs. isodiametric). The two species may also be separated ecologically, with *S. clivemarshii* restricted to Miocene Melange outcroppings whereas *S. venusta* occurs lithophytically or chasmophytically on Karst limestone (Boyce et al. 2019).

Distribution and ecology. Endemic to Sabah. Known only from two separate localities, approximately 10 km distant, the Danum Valley Conservation Area. Restricted to Miocene Melange outcroppings through Cretaceous deepwater sediments in lightly shaded lowland perhumid forest between elevation 215 m and 310 m elev.

Schismatoglottis crinitissima A.Hay

Material examined. MALAYSIA – **Pedalaman** • Tambunan, Gunung Trus Madi, 5°33′12.8″N 116°31′0.1″E, 24 August 1988, Asik mantor SAN 125582 (SAN).

Identification. *Schismatoglottis crinitissima* is unique in the genus because of its multicellular hairs on petiole, blade margins, both adaxial and abaxial surfaces (Hay and Yuzammi 2000).

Distribution and ecology. Southwest Sabah. Terrestrial in disturbed lowland forest at ca. 200 m elev.

Schismatoglottis decipiens A.Hay

Material examined. MALAYSIA – **Sandakan** • Kinabatangan, Tongod, Gunung Tingkar; 05°18′59″N, 117°09′00″E; 550 m elev.; 24 August 1992; K. M. Wong 2218 (L) • Sandakan, Bidu-bidu Hills; Porog; [05°50′49″N, 117°15′41″E]; 1 June 1964; W. Meijer SAN 41246 (SAN) • Sandakan, Ulu Tungud, Telupid, Kg. Bauto; 05°39′30″N, 117°12′27″E; 91.44 m (300 ft.).; 24 July 1980; Dewol Sundaling SAN 92427 (SAN).

Identification. *Schismatoglottis decipiens* is closely allied to *Schismatoglottis trivittata* Hallier, *Schismatoglottis motleyana* Engl. and other allied species with hapaxanthic stems, fully attached leaf sheaths and caducous spathe limbs. *Schismatoglottis decipiens* has a unique combination of features in the staminate zone exserted from the lower spathe chamber, the conspicuous partly naked interstice, the broad flat connective of the stamens, the appendix barely and not abruptly wider than the staminate zone, and the leaves with rather few primary lateral veins and a large number of secondary veins arising from them (a characteristic generally, though not entirely, otherwise associated with species with larger leaves) (Hay and Yuzammi 2000).

Distribution and ecology. *Schismatoglottis decipiens* is endemic to Sabah. Terrestrial on slopes and rocky sites in forest over ultramafic substrate at elevations of ca. 100–400 m.

Schismatoglottis ferruginea Merr.

Material examined. MALAYSIA – **Pedalaman** • Tambunan, Sunsuron, KM45 jalan Tambunan-Penampang; 05°46′48″N, 116°20′43″E; 1300 m elev.; 23 August 1989; Asik Mantor SAN 127890 (SAN) – **Sandakan** • Sandakan, Pinangah, Ulu Sungai Melikop; 05°05′46″N, 116° 36′33″E; 152.4 m (500 ft.) elev.; 1 June 1985; Dewol et al. SAN 109270 (SAN) • Sandakan, Tongod, Maliau Valley, Agathis Camp; 04°50′56″N, 116°50′28″E; 450-500 m elev.; 13 July 2001; Pereira J. T., Postar, de Wilde et al. SAN 144373 (SAN) • Sandakan; [05°51′19″N, 117°53′04″E]; 40 m elev.; September 1920; M. Ramos 1675 (L) • Tongod, Imbak, Pinangah Forest Reserve; 05°10′29″N, 117°09′13″E; 213.36 m elev.; 14 June 2000; Pius et al. SAN 142899 (K, KEP, NSW, SAN) – **Tawau** • Tawau, Bukit Quion, Teck Guan Cocoa Plantation; 04°24′47″N, 118°01′12″E; 150 m elev.; 7 December 2003; P. C. Boyce, J. Linton & A. Surat AR 201.1 (SAR).

Identification. *Schismatoglottis ferruginea* is similar to *Schismatoglottis barbata* Engl. (Sarawak) in the coarsely hairy petiole and the leaf shape tending to be widest distal to midway along the midrib. Both species differs in the not tufted habit, larger size, the distinctly cordate leaf blade base, the hairy and relatively long peduncle, the slender hairy spathe constricted near the base and, presumably from the shape of the spathe, the more or narrowly tapering spadix (Hay and Yuzammi 2000).

Distribution and ecology. Endemic to Sabah. Lithophytic in sandstone crevices by riverbanks or in secondary forest near streams at low elevation. On boulders and terrestrial on rather dry slopes in mixed lowland forest at low elevations.

Schismatoglottis imbakensis Kartini, S.Y.Wong & P.C.Boyce

Literature cited. MALAYSIA – **Sandakan** • Telupid, Imbak Canyon Conservation Area, Sungai Kangkawat; 05°5′05″N, 117°03′20″E; ca. 260 m elev.; 1 Oct 2018; Kartini et al. 2705 (holo, BORH + spirit).

Identification. *Schismatoglottis imbakensis* is distinguished from *S. retinervia* Engl., the only other species of the Patentinervia clade occurring in Sabah, by the plant glabrous (vs. petioles and abaxial midribs puberulous), by the naked sterile interstice of the spadix equalling the pistillate floret zone (vs. naked sterile interstice hardly developed), by the deep green pistils with the stigma about half the width of the ovary (vs. pistils dirty pale green with the stigma almost equalling the ovary width), by the staminate florets somewhat laxly arranged and the stamens readily discernible (vs. staminate florets very densely packed and individual stamens scarcely distinguishable). *Schismatoglottis imbakensis* is distinguished from *S. pichinensis* P.C.Boyce and *S. puncakborneensis* P.C.Boyce, the other two Patentinervia clade species with a long naked sterile interstice, by large rhomboidal cream interpistillar staminodes (vs. interpistillar staminodes lorate or if rhomboidal then small and white), the large, laxly arranged stamens (vs. small and congensted), and sharply pointed (vs. blunt) spadix appendix (Kartini et al. 2020).

Distribution and ecology. Endemic to Sabah. Known only from the type locality on the Sungai Kangkawat, Imbak Canyon Conservation Area. Primary lowland mixed dipterocarp forest on Cretaceous Harzburgite and Serpentinite outcrops, occurring on steep, muddy riverbanks above the flood zone, ca. 270 m elev.

Schismatoglottis lingua A.Hay

Material examined. MALAYSIA – **Pedalaman** • Nabawan, Sungai Maadun, Syt. Benawood, Sungai Maadun; 04°51′31″N, 116°34′48″E; 25 May 1987; Fidilis krispinus SAN 119368 (SAN) – **Sandakan** • Sandakan, Tongod, Maliau Basin Field station; 04°44′10″N, 116°58′37″E; 17 April 1996; A. Hay 12098 (SAN) • same locality; 17 April 1999, A. Hay 12111 (SAN).

Identification. *Schismatoglottis lingua* have similar spadix to *S. calyptrata*, and can be differentiated from its larger size, heavier appendix, solitary long-pedunculate inflorescence, rims of the staminal thecae elevated well above the connective, erect petioles with bases joined by the wings of the sheath into something resembling a pseudostem, the elongated tongue-shaped leaves (Hay and Yuzammi 2000).

Distribution and ecology. *Schismatoglottis lingua* is endemic to Sabah. Stream banks in kerangas forest at 960 m elev.

Schismatoglottis moodii A.Hay

Figure 6E

Material examined. MALAYSIA – **Pedalaman** • Tambunan, Patau, Mahua Waterfall, trail to Gunung Alab; 05°48′01″N, 116°24′13″E; 1173 m elev.; 19 April 2014; Wong Sin Yeng & P. C. Boyce AR 4692 (SAR) – **Pantai Barat** • Penampang, Ulu Babagon Forest Reserve, Kampung Kibunut; 13 April 2004; Joseph B. et al. SAN 148754 (SAN).

Identification. This species resembles *S. trusmadiensis* A.Hay & Mood in the hasto-sagittate leaf blade. It differs in the much more robust stature, the female zone not adnate to the spathe, the shortly cylindric appendix, taller interpistillar staminodes and the narrower connective (Hay and Yuzammi 2000).

Distribution and ecology. Endemic to Sabah. Northwestern Sabah. Terrestrial in secondary forest along a stream at 230 m elev.

Schismatoglottis motleyana (Schott) Engl.

Material examined. MALAYSIA – **Federal Territory of Labuan** • Labuan, T. Motley s.n. (holo, K).

Identification. *Schismatoglottis motleyana* is a highly variable species. It is characterised, within the *S. calyptrata* group, by a slender subcylindric spadix without a sterile interstice (though occasionally there may be a concentration of interpistillar staminodes at the interface

of the two fertile zones), a slender cylindric to very narrowly obconoid male zone held partly within the lower spathe chamber and a subcylindric to very narrowly conoid appendix. However, these are features shared with *S. trifasciata* Engl., another highly variable species, in this case with a very wide range of leaf shape, venation pattern and petiolar ornamentation. The two species can be distinguished by the length/width ratios of the spadix (measured from dried specimens; width taken at the base of the appendix), which are around 40:1 in *S. trifasciata* (range 30:1–50:1) and around 15:1 in *S. motleyana* (range 10:1––22:1 (–26:1)). Plants with the high extreme ratio in *S. motleyana*, which are unusual, approach the low extreme ratio in *S. trifasciata*, and so these two species can be difficult to separate at the extremes of their variation (Hay and Yuzammi 2000).

Distribution and ecology. Labuan endemic, but is never refound. Terrestrial (rarely lithophytic) on secondary and mature rainforest floor and in disturbed sites (rubber plantations) over a variety of substrates; sea level to ca. 1400 m elev.

Schismatoglottis porpax S.Y.Wong, Kartini & P.C.Boyce

Material examined. MALAYSIA – **Pantai Barat** • Kota Kinabalu, Inanam, Kionsom Waterfall; 05°58′26″N, 116°12′30″E; 270 m elev., Wong Sin Yeng & P. C. Boyce AR-4684 (holo, SAN, iso, SAR).

Identification. *Schismatoglottis porpax* is most similar to *S. hayi* S.Y.Wong & P.C.Boyce, a species endemic to the forested Karst limestone of Niah Caves in northeastern Sarawak (Wong and Boyce 2011), notably in the leaf blade shape and pubescent petioles. It can, however, be distinguished from that species by leaf blades not producing adventitious plantlets, and by the longer, narrower pistillate flower zone, the much smaller sub-pistillar staminodes (the smallest so far known in the Multinervia Complex), a sparsely-cloted interstice with staminodes about half the size of those in *S. hayi*, and by a narrower appendix. The elongated leaf blades of *S. porpax* are quite different to the ovate blades of *S. multinervia* M.Hotta (Boyce and Wong 2015), a species restricted to the forested Karst formations in the Mulu National Park, while the spadix of the two species differs in several key characteristics (Wong et al. 2019).

Distribution and ecology. Endemic to Sabah. Known only from the type locality at Kionsom waterfall when it occurs in abundance along a 500 m stretch of the trail to the first waterfall. Moist lowland forest growing on Oligocene deep water sandstones, mostly occurring on the lower parts of shady and rocky banks kept permanently wet by seepage, elevations between 200 and 300 m.

Schismatoglottis priapica S.Y.Wong, Kartini & P.C.Boyce

Material examined. MALAYSIA – **Tawau** • Lahad Datu, Danum Valley Conservation Area, trail to Tembaling Falls; 04°56′31″N, 117°48′31″E; 235 m elev., 8 July 2018; Wong Sin Yeng, P.C. Boyce & Kartini Saibeh BORH 2704 (holo SAN, iso SAR)

Identification. *Schismatoglottis priapica* may not have any species it is clearly related to and is it distinct from its erect and self-supporting stem. *Schismatoglottis priapica* has unique aerial stems with conspicuously elongated internodes occurs in the Multiflora clade (*Schismatoglottis erecta* M.Hotta and *Schismatoglottis schottii* Bogner & Nicolson), the Nervosa clade (most species), the Calyptrata clade (*Schismatoglottis convolvula* P.C.Boyce, *Schismatoglottis niahensis* A.Hay), in the still unplaced *Schismatoglottis conoidea* Engl. and *Schismatoglottis evelyniae* P.C.Boyce & S.Y.Wong, and in an undescribed species from Mulu National Park (Boyce et al. 2019).

Distribution and ecology. Endemic to Sabah. Known only from one locality in the Danum Valley Conservation Area. Lowland mixed dipterocarp forest on deep alluvial sandy-loamy soils overlaying Cretaceous deep-water sediments.

Schismatoglottis retinervia Furtado

Material examined. MALAYSIA – **Pedalaman** • Keningau, Crocker Range area, Kimanis road, Mile 16; 05°51′15″N, 116°18′50″E; 23 August 1986; Fidilis Krispinus SAN 120565 (SAN) • Sipitang, Sungai Long Pasia; 04°24′24″N, 115°43′58″E; 3 September 2002; Postar & Geoffrey D. SAN 145767 (K, SAN) – **Pantai Barat** • Ranau, Mount Kinabalu, Tenompok; 06°05′30″N, 116°32′45″E; 1524 m elev.; 26 March 1932; Clemens & Clemens 29153 (L) • Ranau, Masilau, Pinosok Plateu, Kinabalu; 06°02′05″N, 116°36′56″E; 1371.6 m (4500 ft.) elev.; 27 July 1963; W. Meijer SAN 25472 (SAN).

Identification. The somewhat elongate sprawling habit, in which the plants may form clonal colonies, together with the membranous, elliptic leaves with spreading primary and conspicuously tessellate tertiary venation and the solitary inflorescence suggest affinity with species such as *S. patentinervia* Engl. and *S. brevicuspis* Hook.f. (Malay Peninsula) (Hay and Yuzammi 2000).

Distribution and ecology. Endemic to Sabah. Terrestrial in mid-montane forest near streams (but not rheophytic) at ca. 1200–1500 m elev.

Schismatoglottis saafiei Kartini, P.C.Boyce. & S.Y.Wong

Material examined. MALAYSIA – **Pedalaman** • Keningau, Ulu Senagang; 05°21′51″N, 116°01′26″E; 558 m elev.; Suzana S. SAN 151904 (SAN).

Identification. A species of the *Trifasciata* complex as characterised by elongated slender subcylindric spadix with the staminate flower zone held partly within the lower spathe chamber and densely arranged staminodes of appendix with rounded to pointed tips, but immediately distinguished from all other described species of this complex by the unique thinly rubbery brilliant green leaf blades (Kartini et al. 2017).

Distribution and ecology. Endemic to Sabah. Known only from the type locality in Tawau Hills Park on the banks of Tiku River along the trail to Galas Hill. Grows in open areas and along track sides in lowland evergreen perhumid forest on basalts at elevation about 100 m and is so far known only from the type locality where it is locally abundant.

***Schismatoglottis scintillans* Scherberich & P.C.Boyce**
Figure 6F

Literature cited. MALAYSIA – **Pedalaman** • Keningau, Apin Apin, 16 km on village road, west, and 2 km walk along Apin Apin river to 610 m ("2000 ft") elev.; 23 Jan 1993; J. Mood 563 (holo K, iso LYJB, SAN, SAR).

Identification. *Schismatoglottis scintillans* most closely approaches *S. decipiens* A.Hay and *S. trusmadiensis* by the pistillate flower zone extensively (≥ ½) adnate to the spathe, but it is readily distinguished from both species by the combination of a much longer proportion of this adnation (5/6 of the entire pistillate zone vs. ½), and by scintillating leaf blades. *Schismatoglottis scintillans* is specifically distinguished from *S. decipiens* by the staminate flower zone half enclosed (not fully exerted) from the lower spathe, and by lacking a naked interstice between the staminate and pistillate zones. From *S. trusmadiensis, S. scintillans* is further distinguished by a bullet-shaped appendix being much wider than the top of the staminate flower zone (vs. appendix bluntly conoid, and indistinctly wider than the top of the staminate zone) and by the overall much more compact stature, and ovate-sagittate, variegated, velvety leaf blades (vs. hastate-sagittate, plain glossy green) (Scherberich and Boyce 2013).

Distribution and ecology. Endemic to Sabah. Known only from the type locality in Keningau, Apin Apin, elevation ca. 610 m ("2000 ft"). Grows terrestrially in very shaded riverine forests on wet alluvial soils, at ca. 600 m elev.

***Schismatoglottis silamensis* A.Hay**

Material examined. MALAYSIA – **Tawau** • Lahad Datu, Sapagaya VJR, Ultramafic, near rocky stream; 16 February 2012; 04°58′13″N, 118°05′12″E; 249 m elev.; Suzana S. et al. SAN 151427 (SAN).

Identification. *Schismatoglottis silamensis* is allied to *S. calyptrata*, *S. motleyana, S. trivittata and S. trifasciata*—variable species which tend to approach each other at the extremes of their variation. In this widespread alliance, *S. silamensis* is distinguished by the short interpistillar staminodes occurring in very large numbers in the female zone, the rather well-defined sterile interstice composed of abortive pistils and anthers, and its coriaceous leaves which have rather unusual variegation in three shades of green. It represents a local endemic segregate on ultramafic substrate (Hay and Yuzammi 2000).

Distribution and ecology. Endemic to Sabah. On rocks on (dry) stream bank in rather dry mixed lower montane forest on ultramafic substrate at ca. 500 m elev.

***Schismatoglottis tahubangensis* A.Hay & Hersc.**

Material examined. MALAYSIA – **Pantai Barat** • Just outside Kinabalu Park, 100 m to Tahubang River along route to Marai Parai, 11,000 m elev.; 12 September 1993; J. Nais, Dolois, Harry & Masius SP05312 (holo, KEP).

Identification. *Schismatoglottis tahubangensis* somewhat resembles *Schismatoglottis platystigma* M.Hotta (Brunei) in having discoid stigmas and relatively small thecae on the edge of a broad connective. However, it is readily distinguished from that species by the presence of interpistillar staminodes, the subsessile stamens with a much higher connective and slender spadix (Hay and Herscovitch 2003).

Distribution and ecology. Endemic to Sabah. Known only from the type locality, Tahubang river, Kinabalu Park. On a steep slope in unspecified vegetation type at ca. 1,100 m elev.

***Schismatoglottis trifasciata* Engl.**

Material examined. MALAYSIA – **Pantai Barat** • Ranau, Kinabalu, Penibukan (Bahandoi), Sungai Tahobang; [06°05′30″N, 116°32′45″E]; 1000 m elev.; 11 March 1970, H. P. Nooteboom 1545 (L) • Ranau, Bukit Hampuan Forest Reserve; 6°01′23″N, 116°39′51″E; 767 m elev.; 13 May 2010; Suzana S. SAN 151078 (SAN) – **Sandakan** • Kinabatangan, Tibau Forest Station; 04°30′00″N, 116°45′00″E; 450 m elev.; 7 April 1996; A. Hay 12029 (SAN) • same locality; 350 m elev.; 21 April 1996; A. Hay 12137 (SAN) • Kinabatangan, Kalabakan VJR, cultivated at Glasshouse at Royal Botanic Gardens Sydney; 04°27′01″N, 116°59′27″E; 300 m elev.; 7 April 1996; A. Hay 12016 (SAN) • Kinabatangan, Maliau Basin, Gunung Rara Forest Reserve, 2.5km above Maliau Falls; 04°30′00″N, 116°45′00″E; 530 m elev.; 14 April 1996; A. Hay 12094 (SAN) • Kinabatangan, Gomantong Caves, cultivated at glasshouse at Royal Botanic Gardens Sydney; 05°31′52″N, 118°04′17″E; 300 elev.; 24 April 1996; A. Hay 12171 (SAN) • Kinabatangan, Gomantong, Gomantong Caves; [05°31′33″N, 118°04′24″E]; 50 m elev.; 25-26 September 1968; K. Ogata 10973 (L) • Kinabatangan, Gunung Rara Forest Reserve 2.5km above main Maliau Falls, cultivated at glasshouse at Royal Botanic Gardens Sydney; 04°30′00″N, 116°45′00″E; 530 m elev.; 10 April 1996; A. Hay 12062 (L, SAN) • Sandakan, Sepilok Forest Reserve, cultivated at glasshouse at Royal Botanic Gardens Sydney; 05°49′36″N, 117°57′04″E; 23 April 1996; A. Hay 12150 (SAN) • same locality; 23 April 1996; A. Hay 12155 (SAN) • same locality; 23 April 1996; A. Hay 12156 (SAN) • Sandakan, Kabili Forest Reserve; 05°48′36″N, 117°59′21″E; 13 m elev.; 17 September 1938; M. Puasa 9943 (L).

Identification. *Schismatoglottis trifasciata* is treated as a species complex and highly polymorphic (Hay and Yuzammi 2000).

Distribution and ecology. Northwestern and northeastern Sabah. Terrestrial on rainforest floor, sea level to ca. 1200 m elev.

Schismatoglottis trivittata Hallier

Material examined. MALAYSIA – **Kudat** • Banguey island; [07°15′08″N, 117°09′23″E]; 6 April 1905; P. Castro 1343 (P).

Identification. The current concept of *Schismatoglottis trivittata* is of a variable, widespread and rather scattered species. In inflorescence it is only distinguishable from *S. niahensis* A.Hay by the sterile interstice usually lacking a zone of sterile anthers and by the connective being less clearly elevated into a low peak between the thecae. However, the leaf is relatively shorter and broader, without the very broad midrib and primary veins characteristic of *Schismatoglottis niahensis* A.Hay. More importantly, the stem is hypogeal and hapaxanthic in *S. trivittata* where it is epigeal and pleionanthic in *S. niahensis* (Hay and Yuzammi 2000).

Distribution and ecology. Widespread but scattered in Sabah. Lowland rainforest floor and elevated soil patches in swampy forest, and low montane forest; sea level to 1000 m elev.

Schismatoglottis trusmadiensis A.Hay & J.Mood

Literature cited. MALAYSIA – **Pedalaman** • Tambunan, Kengaran Distr., Trus Madi, Cult. Haleiwa, Hawaii J. Mood s.n (orig. coll. Mood M791a) (holo NSW + NSW spirit).

Identification. This species is similar in leaf shape to the more robust *S. moodii*. It differs from that species in the female zone of the spadix relatively longer and half adnate to the spathe, the shorter interpistillar staminodes, the stamens with small pores separated by a rather thick connective, the obtusely conoid appendix not abruptly thicker than the male zone, and the smaller diameter appendical staminodes (Hay and Yuzammi 2000).

Distribution and ecology. *Schismatoglottis trusmadiensis* is endemic to Sabah. Known only from the type locality on Gunung Trus Madi. Terrestrial in secondary forest at 920 m elev.

Schismatoglottis unifolia A.Hay & P.C.Boyce

Material examined. MALAYSIA – **Pedalaman** • Keningau, Ulu Senagang sub-station; 05°21′60″N, 116°01′34″E; 566 m elev.; 18 May 2010; Markus G. SAN 151778 (SAN) • Tenom, Ulu Senagang; 05°21′01″N, 116°01′03″E; 470 m elev.; 21 October 1999; P. C. Boyce 1432 (K).

Identification. *Schismatoglottis unifolia* is known only from the type locality. The affinities of this species are rather unclear, as it has hapaxanthic shoots restricted to the *Schismatoglottis calyptrata* group, but it also has irregular abscising and disintegrating (rather than caducous) spathe limb implying it to the *Schismatoglottis asperata* group. *Schismatoglottis unifolia* has unusual breeding system in the genus as the male zone held within the lower spathe chamber like in *Schismatoglottis pudenda* A.Hay and *Schismatoglottis grabowskii* Engl. (Hay and Yuzammi, 2000).

Distribution and ecology. Endemic to Sabah. Terrestrial in deep leaf litter over sandy loam in secondary gallery forest on a steep slope, at 470 m elev.

Schismatoglottis venusta A.Hay

Material examined. MALAYSIA – **Sandakan** • Kinabatangan, Gomantong hill, bottom of Libingpayu hole; 05°31′52″N, 118°04′17″E; 15.24 m (50 ft.) elev.; 21 July 1954; G. H. S. Wood A 4602A (SAN) • same locality; 15.24 m (50 ft.) elev.; 27 September 1948; Austin Cuadra A 1490 (SAN) • same locality; 21 June 1992; W. Meijer SAN 136165 (SAN) • same locality; 21 June 1992; W. Meijer SAN 136168 (SAN) • same locality; 300 m elev.; 24 April 1996; A. Hay 12167 (SAN) • Kinabatangan, Gomantong Forest Reserve, Dulong lambu limestone massif, Gomantong limestone hill, Simud Hitam Cave; 05°31′22″N, 118°03′50″E; 50 m elev.; 21 May 1996; S. P. Lim 605 (SAN) – **Tawau** • Lahad Datu, Madai Caves, cultivated at glasshouse at Royal Botanic Gardens Sydney; 04°43′45″N, 118°08′00″E; 400 m elev.; 25 April 1996, A. Hay 12179 (SAN).

Identification. This species is clearly allied to *S. calyptrata*, sharing the hapaxanthic modules, sagittate leaf blade, caducous spathe limb and hourglass- shaped spadix with partially adnate female zone. It differs in the very dark green somewhat coriaceous (almost subsucculent) leaves, lithophytic habit, larger pistils, shorter and wider interpistillar staminodes and the shortly cylindric appendix (Hay and Yuzammi 2000).

Distribution and ecology. Endemic to Sabah. Northeastern and eastern Sabah. Lithophytic on limestone (occasional on nearby forest floor) in mixed dipterocarp forest, ca. 50–400 m elev.

Schismatoglottis wongii A.Hay

Material examined. MALAYSIA – **Pantai Barat** • Penampang, Moyog, along road between Kota Kinabalu and Tambunan, 21 miles SE of Kota Kinabalu, W slopes of Crocker Range; 05°50′N, 116°14′E; 460 m elev.; 26 September 1981; T. B. Croat 53111 (SAR, MO) – **Sandakan** • Sandakan, Ulu Dusun, 05°47′05″N, 117°45′50″E; 1 March 1995; A. Hay 10026 (K) • Sandakan, Sepilok Forest Reserve, cultivated at glasshouse at Royal Botanic Garden Sydney; 05°49′36″N, 117°57′04″E; 23 April 1996; A. Hay 12154 (SAN) – **Tawau** • Tawau, Bukit Quoin, Teck Guan Cocoa Plantation; 05°18′14″N, 118°44′45″E; 150 m elev.; 7 December 2003; P. C. Boyce, J. Linton & A. Surat AR 200 (SAR).

Identification. Previously it was only known from the type locality in Sepilok Forest Reserve. *Schismatoglottis wongii* is similar in habit to *Schismatoglottis longispatha* W.Bull but differs in the cordate leaf base and dimerous anthers. *Schismatoglottis wongii* have horticultural potential as ormentals especially variegiated forms of *Schismatoglottis wongi* (Hay and Yuzammi 2000).

Distribution and ecology. Endemic to Sabah. Forming dense clonal carpets sometimes several metres across on the floor of mixed lowland dipterocarp forest at low elevation.

***Schismatoglottis zainuddinii* Kartini, P.C.Boyce & S.Y.Wong**

Material examined. MALAYSIA – **Tawau** • Cultivated at Institute for Tropical Biology and Conservation, Kota Kinabalu; 22 Feb 2016; Kartini BORH 4405 (BORH) [original collection: Malaysian Borneo, Sabah, Tawau, Tawau Hills N.P., Tiku River; 04°22 'N, 117°54'E; 19 Feb 2016].

Identification. A species distinguished from all other species of the *S.* Asperata clade by leaf blades glossy, bright medium green above and matte, pale green below, densely minutely asper- ous, glossy, deep green petioles, and older plants with a much-elongated decumbent stem. Differentiated from *S. sejuncta* A.Hay (geographically the closest species) by having staminate and pistillate flower zones contiguous (not separated by a well-defined and conspicuous naked sterile interstice) (Kartini et al. 2017).

Distribution and ecology. Eastern Sabah. Tawau Hills Park on the banks of Tiku River along the trail to Galas Hill. Occurs on steep slopes and earth banks over basalt in wet lowland to hill forest elevation between 90 and 330 m.

***Scindapsus crassipes* Engl.**

Material examined. MALAYSIA – **Pedalaman** • Sipitang, Long Pasia, Ulu Padas, Bukit Busur, 338.328 m (1110 ft.) elev.; 27 January 2003; Dolois S. SP 18081 (SAN) – **Sandakan** • Beluran, Hutan Simpan Timinimbang, (B) Compartment 52, Near 1st plot of ecology team; 05°59′33″N 117°06′08″E; 96 m elev.; 20 February 2014; Nur Adillah 156305 (SAN) • Kinabatangan, Maliau Basin, Gunung Rara Forest Reserve, 2.5KM above main Maliau Falls; 530 m elev.; 9 April 1996; A. Hay 12030 (SAN).

Identification. Trichosclereids abundant. Solitary, leaf-litter-trapping, bole perching.

Distribution and ecology. *Scindapsus crassipes* is endemic to Borneo. Southwestern and northeastern Sabah.

***Scindapsus curranii* Engl. & K.Krause**

Material examined. MALAYSIA – **Pedalaman** • Pandewan, Sungai Pementarian; 04°58′12″N, 116°25′24″E; 13 February 1987; Sumbing Jimpin SAN 119952 (BORH, SAN) • Tenom, Sungai Kaang; Asik Mantor SAN 120266 (SAN, UKMS) – **Pantai Barat** • Ranau, Bukit Kulung; 06°01′26″N, 116°40′18″E; 6 October 1987; W. Meijer SAN 122424 (SAN) • Ranau, Mount Kinabalu, Kinabalu; 06°05′30″N, 116°32′45″E; Clemens & Clemens, s.n. (L) • same locality; 1371.6 m (4500 ft.) elev.; 5 September 1961; W. L. Chew, E. J. H. Corner & A. Stainton RNSB 2770 (SAN) • same locality; 1284.96 m (52000 ft.) elev.; 10 September 1961, W. L. Chew, E. J. H. Corner, A. & Stainton RNSB 2940 (SAN) • same locality; 1284.96 m (52000 ft.) elev.; 18 April 1964; W. L. Chew & E. J. H. Corner RNSB 4939 (SAN) • Ranau, Poring; 06°02′53″N, 116°42′06″E; 457.2 m (1500 ft.) elev.; 3 October 1987; W. Meijer et al. SAN 122513 (SAN) • Ranau, Tenompok; 05°58′58″N, 116°30′40″E; 1524 m elev.; 9 May 1932; Clemens & Clemens 29617 (P) – **Sandakan** • Beluran, Ulu Tungud Forest Reserve; 05°48′51″N, 117°07′16″E; 188.976 m (620 ft.) elev.; 17 August 2004, J. B. Sugau SAN 145513 (SAN) • Ranau, Mount Kinabalu; [06°05′30″N; 116°32′45″E]; 1645.92 m (5400 ft.) elev.; date unknown; Cockburn SAN 76802 (SAN) • Sandakan, Sepilok Forest Reserve; 05°49′36″N, 117°57′04″E; 17 December 1990, W. Meijer SAN 131689 (SAN) • Sandakan, Tongod, Lamag; 05°28′29″N, 117°49′24″E; 21 March 1980; L. Madani SAN 92041A (SAN) • Sandakan, Ulu Dusun; 05°47′06″N, 117°46′18″E; 15.24 m (50 ft.) elev.; 2 September 1977; S. Lantoh SAN 87917 (L, SAN) • Telupid; 05°39′35″N, 117°03′08″E; 19 March 1974; Aban & Saikeh SAN 79412 (SAN) – **Tawau** • Kalabakan; 04°24′30.″N, 117°29′00″E; 16 October 1999; Fedilis & Sumbing SAN 91332 (SAN) • Tawau Hill Park; 04°23′00″N, 117°53′00″E; 29 June 2006; Julia et al. SAN 147009 (SAN, SAR).

Identification. Herb. Climbing along small tree stems in wet sand gravelly soil of very humid forested flats and along streams at 750 feet; stem or stems bendable, less than one-half of an inch thick, subterete, dark or dull green, from 10 to 15 feet high, ringed every 3 to 5 inches, taking rootlets at the joints, more or less crooked, occasionally branched along the main stem but profusely branched toward the top; the ultimate branches long, curved and drooping, becoming interlaced, at first descending, finally ascendingly curved toward their tips, as thick as a man's small finger, of the same green color as the stems; woody fibers tough and yellowish, the whitish pith relatively large; leaf blades pendant from ascending involutely twisted green herbaceous stalks or petioles, flat and paler green on the nether side. Inflorescence erect, 3 inches long, one half to three quarters of an inch thick, fusiform, glaucous black, in the early state clothed with a smooth shining-green sheath or spathe which with maturity turns creamy yellow or creamy white on the inside; spadix or cob quite thick and rigid, terminated in a green, slender and curved point; florets sulphureus except the green margins between the individuals. Infructescence with fruiting spike erect, terete, very dark or a sort of metallic green or dull dark green.

Distribution and ecology. Northwestern, Southwestern, and northeastern Sabah. Mainly well-drained perhumid to everwet broadleaf forest at low to middle elevations.

***Scindapsus kinabaluensis* (Furtado) Kartini & P.C.Boyce**

Material examined. MALAYSIA – **Pedalaman** • Keningau, Crocker Range Forest Reserve, Mile 16 Highland Plantation; [05°51′15″N, 116°18′50″E]; 1219.2 m (4000 ft.) elev.; 12 June 1977; A. H. Talip SAN 87006 (SAN) • Keningau, Hutan Simpan Trus Madi, Sinua; 05°30′21″N, 116°34′47″E; 1524 m elev.; 29 October 2011; Sugau J. B. SAN 153390 (K, KEP, SAN) • Keningau, Ulu Sungai

Sembuan Tulid; 04°47′30″N, 116°11′33″E; 27 September 1988; Fedilis K. SAN 1501 (NWS, SAN) • Pensiangan, Pensiangan kayu; 06°05′30″N, 116°32′45″E; 17 January 1994; Asik Mantor SAN 28487 (SAN) • Sipitang, lower slope of Bukit Rimau, approximately north of Long Miau, lower montane heath forest; 04°27′58″N, 115°42′11″E; 1200 m elev.; 12 April 2000; Lim S. P., SAN 143207 (SAN) • Sipitang, Maligan Forest Reserve; 04°34′26″N, 115°37′22″E; 1219.2–1524 m (4000–5000 ft.) elev.; 13 July 1991; Leopold M. SAN 132712 (SAN) • Sipitang, Sungai Tamaki, ridge at upper Sungai Tamaki; 04°26′52″N, 115°47′49″E; 1600 m elev.; 14 April 2000; Lim S. P., SAN 143194 (K, NSW) • Sipitang, Ulu Meligan, Ridge East of Meligan Forest Reserve, Lower Montane Forest; 04°41′28″N, 115°41′18″E; 1880 m elev.; 11 April 2002; Lim S. P., Postar M. & Petrus Butin SAN 144163 (SAN) • Tambunan, Alab, between Agriculture Exp. Station and Kampung Garib, Mount Alab; 05°49′43″N, 116°20′28″E; 1300 m elev.; 14 December 1968; Kokawa & Hotta 2222 (L) • Tambunan, Alab, Mount Alab; 05°50′N, 116°20′E; 2000 m elev.; 31 August 1986; E. F. Vogel 8673 (L) • Tambunan, Gunung Alab, Gunung Alab KM 64; 05°49′43″N, 116°20′28″E; 1 July 1984; Amin G. SAN 60141 (SAN, UKMS) • same locality; 12 August 1987; Sumbing J. SAN 121678 (SAN) • same locality; 27 July 2010; Sugau J. B., Markus G. & Ubaldus SAN 152185 (SAN) • same locality; 17 August 1988; Asik Mantor SAN 125507 (SAN) • Tambunan, Sunsuron, KM 54 Jalan Tambunan, Penampang; 05°44′38″N, 116°22′45″E; 1649 m elev.; 21 August 1989; Asik Mantor SAN 127861 (SAN) – **Pantai Barat** • Mount Kinabalu, Mesilau Cave; 05°59′11″N, 116°36′17″E; 1828.8 m (6000 ft.) elev.; 2 April 1964; W. L. Chew & E. J. H. Corner, RSNB 4801 (SAN) • Penampang, Bongkok, Mount Alab, Bukit Bongkok; 05°51′43″N, 116°18′55″E; 1500 m elev.; 10 December 1968; Kokawa & Hotta 1665 (L) • Penampang, Sunsuron, Path of Kg. Longkungan KM 51; 05°45′02″N, 116°22′05″E; 19 September 1987; Madani & George SAN 119277 (SAN) • Penampang, Tungol, KM 45 Penampang-Tambunan; 05°46′48″N, 116°20′43″E; 18 September 1991; Sumbing J. SAN 131422 (SAN) • Ranau, Bambangan River; 05°58′30″N, 116°38′45″E; 21 May 1986; Amin et al. SAN 114366 (SAN) • Ranau, Bambangan; 05°58′30″N, 116°38′45″E; 10 September 1987; Amin et al. SAN 121008 (SAN) • Ranau, Kamburungoh, Mount Kinabalu, Upper Kinabalu; [06°02′19″N, 116°32′56″E]; 2439 m elev.; 29 March 1932; Clemens & Clemens 26713 (L) • Ranau, Kinabalu National Park, above headquarters; 06°00′38″N, 116°32′32″E; 1676.4 m (5500 ft.) elev.; 23 September 1965; A. Kanis SAN 50126 (SAN) • Ranau, Kinabalu National Park, Bundu Tuhan Trail; [06°00′22″N, 116°32′42″E]; 1676.4 m (5500 ft.) elev.; 29 November 1966; W. Meijer SAN 57532 (SAN) • Ranau, Kundasang, Kinabalu Park, Pig Hill; 06°00′15″N, 116°33′00″E; 28 January 1999; Lim S. P. et al. SNP 9059 (SAN) • Ranau, Kundasang, Mesilau, park golf course development; 06°02′01″N, 116°35′53″E; 25 April 1991; Jamili Nais SNP 4287 (SAN) • Ranau, Kundasang, Mount Kinabalu, above Sosopodon; [06°00′15″N, 116°33′00″E]; 1524 m (5000 ft.) elev.; 2 February 1962; W. Meijer SAN 29020 (K, L) • Ranau, Kundasang, Pinosok Plateu, golf course area; 05°59′34″N, 116°33′49″E; 1676.4 m (5500 ft.) elev.; 26 December 1990; W. Meijer, Tany & A. Lamb SAN 131930 (SAN) • Ranau, Mesilau, Mesilau River; [05°59′08″N, 116°36′28″E]; 1524 m (5000 ft.) elev.; 2 April 1964; W. L. Chew & E. J. H. Corner, RSNB 4864 (SAN) • Ranau, Mosilon; 05°59′08″N, 116°36′28″E; 12 September 1988; Amin G. SAN 123458 (SAN) • Ranau, Mount Kinabalu, Colombon River; [06°05′30″N, 116°32′45″E]; 1371 m elev.; 6 June 1933; Clemens & Clemens 35128 (L) • Ranau, Mount Kinabalu; [06°05′30″N, 116°32′45″E]; 914.4 m (3000 ft.) elev.; 1 September 1931; Clemens & Clemens 26243 (L) • same locality; 914.4 m (3000 ft.) elev.; 17 August 1931; Clemens & Clemens 261 (P) • same locality; 914.4 m (3000 ft.) elev.; 17 August 1931; Clemens & Clemens 26121 (L) • same locality; 914.4 m (3000 ft.) elev.; 27 December 1931; Clemens & Clemens 28142 (L) • same locality; 1829 m elev.; 8 April 1932; Clemens & Clemens 29181 (L) • Ranau, Mount Kinabalu, Kiau View Trail; [06°05′30″N, 116°32′45″E]; 1645.92 (5500 ft.) elev.; Cockburn SAN 76814 (SAN) • Ranau, Pinosok, Pinosok Plateu, Kinabalu Above Royal Society Camp; [06°05′30″N, 116°32′45″E]; 1524 m (5000 ft.) elev.; 26 July 1963; W. Meijer SAN 38052 (SAN) • Ranau, Tenompok; [06°05′30″N, 116°32′45″E]; 1524 m elev.; 26 May 1932; Clemens & Clemens 26875 (P) – **Sandakan** • Telupid, Tawai, Summit of Tawai; 05°31′51″N, 117°06′17″E; 7 April 1994, Bahaman et al. SAN 134256 (SAN) • Sandakan, Tawai Forest Reserve, Bukit Talibu, 05°31′59″N 117°06′00″E; 6 April 1994, Cheksum Tawan CST 171 (SAN) – **Tawau** • Kunak, Madai Caves; 4°43′45″N 118°08′00″E, 8 July 2000; Diwol S. & Ruth Kiew et al. SAN 133147 (K, SING) • Kalabakan, Bukit Tuku, Mile 8, Luasong; 04°36′42″N, 117°27′04″E; 20 July 1982; Fedilis Krispinus SAN 95887 (SAN).

Identification. *Scindapsus kinabaluensis* belongs to the informal *Scindapsus* Coriaceus Complex (*sensu* Kartini 2001) defined by thickly coriaceous leaf blades with all venation rather obscure, or at most the primary lateral veins visible, smooth stems, a semi-terrestrial to scandent shrubby habit, at most low-climbing, a marked preference for exposed situations in *kerangas*, and solitary inflorescences with a thick to very thick leathery tough spathe. The complex is pre-eminently Bornean, with only *S. scortechinii* (Peninsular Malaysia and S Thailand) occurring outside Borneo (Kartini et al. 2015b).

Distribution and ecology. Endemic to Sabah. North and South Crocker Ranges, notably around Mount Kinabalu, extending to the Sir James Brooke Range to the North of Kinabalu National Park. Low climber or scandent semi-terrestrial shrub in scrubby ridgetop kerangas or open kerangas forest on slopes elevation between 1400 and 2500 m.

***Scindapsus longipetiolatus* Ridl.**

Material examined. MALAYSIA – **Pedalaman** • Tambunan, Rafflesia Forest Reserve Rafflesia, trail behind Rafflesia Information Centre; 05°46′42″N, 116°20′28″E; 14 May 2011; P. Leong 453 (SAN, SING) – **Tawau** • Lahad Datu, Danum Valley Field Centre; 04°57′30″N, 117°41′47″E; 19 February 1992; A. Berhaman SAN 134403 (SAN) • Lahad Datu, Segama River Forest Reserve; 04°57′42″N, 117°49′57″E; 18 March 1985; Leopold M. & Ismail SAN 108616 (SAN) • Tawau, Tawau Hills Forest Reserve; 04°23′60″N, 117°53′21″E; 6 July 1974; Aban G. & Free SAN 79670 (SAN).

Identification. Lianes and stem 7 mm. in diameter. This species is superficially similar to *S. longistipitatus* Merr. but is differentiated with a shorter stipe (refer *S. longistipitatus* below).

Distribution and ecology. Southwestern and eastern Sabah. Mainly well-drained perhumid to everwet broadleaf forest at low to middle elevations.

***Scindapsus longistipitatus* Merr.**

Material examined. MALAYSIA – **Pantai Barat** • Ranau, Lohan Ulu; 05°46′03″N, 116°49′07″E; 9 November 1987; Amin & Francis SAN 121419 (SAN) • Ranau, Mount Kinabalu, Dallas; [6°05′30″N, 116°32′45″E]; 914.4 m (3000 ft.) elev.; 914.4 m (3000 ft.) elev.; 17 August 1931; Clemens & Clemens 26171 (L) • Ranau, Mount Kinabalu, Ulu Liwagu & Ulu Mesilau; [06°N, 116°35′E]; 1219.2 m (4000 ft.) elev.; 10 September 1961; W. L. Chew, E. J. H. Corner, A. Stainton RNSB 2941 (SAN) – **Kudat** • Banguey Island, Vigor Forest; [07°16′00″N, 117°09′02″E]; 60 m elev.; 28 July 1923; P. Castro 1345 (K) – **Tawau** • Kalabakan, Ulu Sungai Luasong, Sabah Foundation Area, NBT camp KM 37; 05°08′48″N; 116°17′48″E; 17 January 1984; Fedilis & Sumbing SAN 68774 (SAN) • Tawau River Forest Reserve, along Sungai Tawau between the base camp and hot spring; 04°23′46″N, 117°53′49″E; 300 m elev.; 13 November 1968; Kokawa & Hotta 999 (L).

Identification. *Scindapsus longistipitatus* is strongly characterized among all the described forms of this genus by its long-stipitate spadices, these in fruit being 18–29 cm.

Distribution and ecology. Northern and northwestern Sabah. In primary forests, elevation about 20 m.

***Scindapsus pictus* Hassk.**

Material examined. MALAYSIA – **Pedalaman** • Nabawan, Sungai Pingas-Pingas, maitland over ridge area, hillsides; [05°14′20″N, 116°40′32″E]; 11 July 1986; Fidilis K. & Sumbing J. SAN 115896 (SAN) • Sipitang, near montane Muruk Miau, Lower Montane Oak–Chestnut Forest; 04°21′57″N, 115°50′01″E; 1300 m elev.; 13 April 2000; Pius G. & Dauni S. SAN 143168 (SAN, AAU, NSW) – **Pantai Barat** • Ranau, Mount Kinabalu, along road to summit; 06°04′N, 116°27′E; 2000–2300 m elev.; 27 September 1981; Thomas B. Croat, T. B. Croat 53140 (MO, SAR) • same locality; 2000–2300 m elev.; 27 September 1981; Thomas B. Croat, T. B. Croat 53141 (MO, SAR) • same locality; 06°04′N, 116°27′E; 2000–2300 m elev.; 27 September 1981; Thomas B. Croat, T. B. Croat 53142 (MO, SAR) • Ranau, Mount Kinabalu, Penibukan; [06°05′30″N, 116°32′45″E]; 1219.2–1524 m (4000–5000 ft.) elev.; 4 October 1933; Clemens & Clemens 40601 (L) • Tambunan, Gunung Alab, rain forest; [05°50′N, 116°20′E]; 1600 m elev.; 100 m elev.; 26 February 1969; H. P. Nooteboom, H. P. Nooteboom 1042 (SAN) – **Sandakan** • Beluran, Lungmanis Forest Reserve, roadside; 05°74′N, 117°67′E; 17 December 2009; Pius G. SAN 150776 (SAN) • Sandakan, Kabili, Timbon; 05°47′47″N, 117°53′55″E; 22 November 1989; George M. SAN 125771 (SAN) • Sandakan, Sepilok Forest Reserve, Jalan Kabili cpt. 14; [05°49′36″N, 117°57′04″E], 24.384 m (80 ft.) elev.; 29 March 1965, Patrick P. Sam SAN 49932 (SAN) • Sandakan, Sepilok, Sepilok Forest Research Compt 3, along North South; 05°52′26″N, 117°56′59″E; 14 December 1990; W. Meijer & Dewol S. SAN 131644 (SAN) • Sandakan, Ulu Dusun, fresh water, zone inside mangrove; 05°46′53″N, 117°46′09″E; 28 November 1987; W. Meijer SAN 122736 (SAN) – **Tawau** • Semporna, Bohey Dulang Island; 04°35′59″N, 118°47′04″E; 50 m elev.; 12 October 1998; J. B. Sugau et al. SIP-B 108 (SAN) • Tawau, Brantian, logged area Mile 12, Hap Seng Road; 04°30′58″N, 117°33′26″E; 14 March 1979; Fedilis K. & Sumbing J. SAN 89756 (SAN) • Tawau, Bukit Gemuk Forest Reserve; 04°18′00″N, 117°52′00″E; 17 March 1984; Sumbing J. SAN 103454 (SAN).

Identification. *Scindapsus pictus* is most similar to *S. treubii* Engl. Juvenile plants of *S. pictus* has leaves with a crystalline texture and a smooth, dull grey-green blade variously marked with jagged silver-grey blotches. Flowering plants of *S. pictus* have falcate leaves with little or no posterior lobe development (Bogner and Boyce 1994).

Distribution and ecology. Widespread in Sabah. In a variety of habitats in lowlands to mid-elevation. Usually encountered as a juvenile shingling climber, rarely encountered adult plants form extensive curtains of much-branched stems pendent from the tops of tall forest trees, with the inflorescences born on the tips of the stems.

***Scindapsus treubii* Engl.**

Material examined. MALAYSIA – **Sandakan** • Sandakan, Sepilok Forest Reserve, arboretum trail; 05°49′36″N, 117°57′04″E; 60.96-91.44 m (200–300 ft.) elev.; 15 December 1990; W. Meijer & Dewol SAN 131655 (AA, SAN) • Sandakan, Kebun Cina Forest Research, below waterfall; 05°51′04″N, 118°03′47″E; 20 December 1990; W. Meijer & Dewol SAN 131747 (SAN) • same locality; 05°51′04″N, 118°03′47″E; 20 December 1990; W. Meijer & Dewol SAN 131748 (L, F, SAN).

Identification. Lianes. The leaf blade is narrowly elliptic to very narrowly falcate oblanceolate (juvenile and pre-adult), to oblique-elliptic (adult). The juvenile plants often with the leaf blades grey-banded.

Distribution and ecology. Northeastern Sabah. Usually in well drained subtropical and tropical perhumid to everwet broadleaf subtropical and tropical forest at low to middle elevations.

***Tawaia sabahensis* (S.Y.Wong, S.L.Low & P.C.Boyce) S.Y.Wong & P.C.Boyce**

Material examined. MALAYSIA – **Sandakan** • Tongod, Gunung Tingkar; 05°18′00″N, 117°07′45″E; 167.64 m elev.; 24 August 1992; K. M. Wong & Joseph Radin WKM 2215 (SAN).

Identification. *Tawaia sabahensis* is the only species in *Tawaia* and is unique by the combination of globose thecae and spathulate interpistillar staminodes. In overall aspect, by the nodding spathe on a long, slender peduncle, and by the spathe limb hardly opening at pistillate anthesis and deliquescing acroscopically, spathe recurved and abscises, remained with a 5 mm rim beyond the junction of upper spathe and the persistent lower spathe, upper spathe then marcescent and was partially attached on the persistent lower spathe, thence browning and marcescent during staminate anthesis (Low et al. 2018).

Distribution and ecology. Endemic to Sabah. Occurs as an obligate rheophyte on ultramafic (ultrabasic) river boulders and waterfalls under moist lowland forest, elevation between 135 and 300 m.

***Typhonium roxburghii* Schott**

Material examined. MALAYSIA – **Pedalaman** • Tenom, Rayoh Hill; [05°12′24″N, 115°52′49″E]; 60.96 m elev.; 27 April 1964; J. Ampuria SAN 41466 (K) • Tenom, Agriculture Station, in demonstration garden; 05°10′54″N, 115°59′23″E; 500 m elev.; 16 October 1987; W. Meijer SAN 121365 (SAN) – **Sandakan** • Sandakan, near Duchess of Kent Hospital; 05°51′30″N, 118°06′15″E; 15.24 m elev.; 15 July 1983; Young SAN 96794 (SAN).

Identification. The leaf blades of *T. roxburghii* are commonly trilobed with the sterile flowers spreading and strongly decurved. The distribution of *T. roxburghii* as a native species is still uncertain in marginal areas but is confirmed to be native to Malaysia (Nicolson and Sivadasan 1981). In Sabah, this species is naturalized (Wong 2016).

Distribution and ecology. Southwestern and northeastern Sabah. Ruderal, sometimes on limestone, ca. 50 m elev.

Discussion

Sabah contains about 31% of the 370 described species of Araceae recorded in Borneo (Boyce and Croat 2011). *Schismatoglottis* has the most species (24 spp.), followed by *Pothos* (14 spp.), and *Alocasia* (13 spp.). Although *Homalomena* has only 11 described species, the estimated number of species in Sabah exceeds 100 (Boyce and Croat 2011). These results are similar to those obtained in previous work for Borneo, such as Boyce et al. (2010), Wong (2016), and Low et al. (2018), where *Schismatoglottis* and *Homalomena* are the most diverse genera. In Sarawak alone, *Schismatoglottis* comprises a total of 72 described species (including 51 endemics), representing the most diverse genus in Sarawak (Boyce and Croat 2011). In Sabah, 20 *Schismatoglottis* species are endemic to Sabah, representing 84% of *Schismatoglottis* in Sabah. On the other hand, *Pothos* with 14 described species (including four endemics), represents the second largest genus of Araceae in Sabah. Sabah contains a significant level of endemism, as 44% of the aroid species present in Sabah are endemic. This is true also for other plant families, i.e., begonias (80% endemicity; Sang and Kiew 2014) and orchids (59%; Hassler and Rheinheimer 2020). Apart from *Tawaia*, the only endemic aroid genus, Sabah also harbours a few more endemic genera in Orchidaceae (monotypic *Jejewoodia* Szlach. and *Kipandiorchis* P.O'Byrne & Gokusing), Euphorbiaceae (*Borneodendron* Airy Shaw), Loranthaceae (*Lampas* Danser), and Rubiaceae (*Phyllocrater* Wernham) (Neo et al. 2020).

Our results demonstrate the need to carry out thorough inventories in poorly studied sites, such as exists in Kalimantan, and to stress the importance of floristic and taxonomic studies as the basic tool to advance our knowledge of biodiversity.

Acknowledgements

We thank the curators of SAN, BORH, and SNP for allowing access to their collections.

Authors' Contributions

JJ and WSY contributed to the design and implementation of the research, made identifications, and reviewed herbarium material, and reviewed all versions of the manuscript.

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Appendix

Table A1. List of aroid taxa in Sabah.

Taxon	References
Aglaonema nitidum (Jack) Kunth	This study
Aglaonema simplex Blume	This study
Alocasia cuprea (C.Koch & Bouché) C.Koch	This study
Alocasia longiloba Miq.	This study
Alocasia macrorrhizos (L.) G.Don	This study
Alocasia melo A.Hay, P.C.Boyce & K.M.Wong	This study
Alocasia pangeran A.Hay	This study
Alocasia princeps W.Bull	This study
Alocasia principulus A.Hay	This study
Alocasia puteri A.Hay	This study
Alocasia reginula A.Hay	This study
Alocasia robusta M.Hotta	This study
Alocasia sarawakensis M.Hotta	This study
Alocasia scabriuscula N.E.Br.	This study
Alocasia wongii A.Hay	This study
Amorphophallus hottae Bogner & Hett.	This study
Amorphophallus lambii Mayo & Widjaja	This study
Amorphophallus rugosus Hett. & A.L.Lamb	This study
Amorphophallus tinekeae Hett. & A.Vogel	This study
Amorphophallus venustus Hett., A.Hay & Mood	This study
Amydrium medium (Zoll. & Moritzi) Nicolson	This study
Anadendrum spp.	This study
Arisaema filiforme Blume	Gusman and Gusman (2006)
Arisaema simplicifolium Ridl.	Gibbs (1914)
Arisaema wrayi Hemsl.	Gusman and Gusman (2006)
Bucephalandra danumensis S.Y.Wong, P.C.Boyce & Kartini	This study
Bucephalandra ultramafica S.Y.Wong & P.C.Boyce	This study
Colobogynium tecturatum Schott	Low et al. (2018)
Colocasia esculenta (L.) Schott	Hay (1996)
Colocasia oresbia A.Hay	This study
Cryptocoryne ciliata (Roxb.) Fisch. ex Wydler	This study
Cyrtosperma ferox N.E.Br. & L.Linden	Boyce et al. (2010)
Cyrtosperma merkusii (Hassk.) Schott	Boyce et al. (2010)
Epipremnum falcifolium Engl.	This study
Epipremnum pinnatum (L.) Engl.	This study
Gamogyne burbidgei N.E.Br.	This study
Homalomena galbana Baharuddin & P.C.Boyce	This study
Homalomena gempal Kartini, P.C.Boyce. & S.Y.Wong	This study
Homalomena gillii Furtado	This study
Homalomena kinabaluensis Furtado	This study
Homalomena kionsomensis Kartini, P.C.Boyce & S.Y.Wong	This study
Homalomena marasmiella Kartini, P.C.Boyce. & S.Y.Wong	This study
Homalomena portae-inferni S.Y.Wong, J.Joling & P.C.Boyce	This study
Homalomena rostrata Griff.	This study
Homalomena cf. sarawakensis Ridl.	This study
Homalomena simunii Kartini, P.C.Boyce, & S.Y.Wong	This study
Homalomena vagans P.C.Boyce	This study
Lasia spinosa (L.) Thwaites	This study
Lemna aequinoctialis Welw.	Boyce et al. (2010)
Lemna minor L.	Boyce et al. (2010)
Lemna minuta Kunth	Boyce et al. (2010)
Nabalu corneri (A.Hay) S.Y.Wong & P.C.Boyce	This study
Ooia kinabaluensis (Bogner) S.Y.Wong & P.C.Boyce	This study
Phymatarum borneense M.Hotta	This study
Pistia stratiotes L.	Boyce et al. (2010)
Pothos atropurpurascens M.Hotta	This study
Pothos barberianus Schott	This study
Pothos beccarianus Engl.	This study
Pothos brevistylus Engl.	This study
Pothos cylindricus C.Presl	This study
Pothos fractiflexus J.Joling, Pereira & A.Damit	This study
Pothos insignis Engl.	This study
Pothos kinabaluensis Furtado	This study
Pothos leptostachyus Schott	This study
Pothos longivaginatus Alderw.	This study
Pothos mirabilis Merr.	This study
Pothos motleyanus Schott	This study
Pothos ovatifolius Engl.	This study
Pothos scandens L.	This study
Pursegloveia imbakensis H.Okada, Tsukaya & M.Suleiman	This study
Rhaphidophora fluminea Ridl.	This study
Rhaphidophora korthalsii Schott	This study
Rhaphidophora latevaginata M.Hotta	This study
Rhaphidophora lobbii Schott	This study
Rhaphidophora minor Hook.*f.*	This study
Rhaphidophora puberula Engl.	This study
Rhaphidophora sylvestris (Blume) Engl.	This study
Rhynchopyle loi (P.C.Boyce & S.Y.Wong) S.Y.Wong & P.C.Boyce	This study
Schismatoglottis ahmadii A.Hay	This study
Schismatoglottis clemensiorum A.Hay	This study
Schismatoglottis clivemarshii S.Y.Wong, P.C.Boyce & Kartini	This study
Schismatoglottis crinitissima A.Hay	This study
Schismatoglottis decipiens A.Hay	This study
Schismatoglottis ferruginea Merr.	This study
Schismatoglottis imbakensis Kartini, S.Y.Wong & P.C.Boyce	This study
Schismatoglottis lingua A.Hay	This study
Schismatoglottis moodii A.Hay	This study
Schismatoglottis motleyana (Schott) Engl.	This study
Schismatoglottis porpax S.Y.Wong, Kartini & P.C.Boyce	This study
Schismatoglottis priapica S.Y.Wong, Kartini & P.C.Boyce	This study
Schismatoglottis retinervia Furtado	This study
Schismatoglottis saafiei Kartini, P.C.Boyce. & S.Y.Wong	This study
Schismatoglottis scintillans Scherberich & P.C.Boyce	This study
Schismatoglottis silamensis A.Hay	This study
Schismatoglottis tahubangensis A.Hay & Hersc.	This study
Schismatoglottis trifasciata Engl.	This study
Schismatoglottis trivittata Hallier	This study
Schismatoglottis trusmadiensis A.Hay & J.Mood	This study
Schismatoglottis unifolia A.Hay & P.C.Boyce	This study
Schismatoglottis venusta A.Hay	This study
Schismatoglottis wongii A.Hay	This study
Schismatoglottis zainuddinii Kartini, P.C.Boyce & S.Y.Wong	This study
Scindapsus borneensis Engl. & K.Krause	Kartini et al. (2015b)
Scindapsus crassipes Engl.	This study
Scindapsus curranii Engl. & K.Krause	This study
Scindapsus kinabaluensis (Furtado) Kartini & P.C.Boyce	This study
Scindapsus longipetiolatus Ridl.	This study
Scindapsus longistipitatus Merr.	This study
Scindapsus pictus Hassk.	This study
Scindapsus treubii Engl.	This study
Spirodela polyrhiza (L.) Schleid.	Boyce et al. (2010)
Spirodela punctata (G.Mey.) C.H.Thomps.	Boyce et al. (2010)
Tawaia sabahensis (S.Y.Wong, S.L.Low & P.C.Boyce) S.Y.Wong & P.C.Boyce	This study
Typhonium roxburghii Schott	This study
Wolffia globosa (Roxb.) Hartog & Plas	Boyce et al. (2010)